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Nuclear Terrorism calibrating funding for defensive programs in response to the threat

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NUCLEAR TERRORISM: CALIBRATING FUNDING FOR DEFENSIVE PROGRAMS IN RESPONSE TO THE THREAT

by

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The risk of a nuclear attack by terrorists is one of the most urgent and threatening dangers facing the U.S. The U.S. National Strategy to Combat Weapons of Mass Destruction depicts a layered system of preventive measures ranging from securing materials at foreign sources to interdicting weapons or nuclear materials at ports, border crossings, and within the U.S. Several departments within the U.S. government manage these preventive programs with little cross-departmental integration to determine where additional funds could provide the greatest impact. Furthermore, no governmental office with budgetary or staffing authority exists to direct the overarching effects of these programs and expenditures as a whole.

This study examines the fiscal prioritization and relative effectiveness of the primary U.S. programs to prevent acts of nuclear terrorism contrasted against the threat of a terrorist nuclear attack within the U.S. This effort seeks to bridge departmental lanes of responsibility, provide a holistic perspective, and identify programs in need of additional resources and emphasis, as well as efforts that offer comparatively little added security. This research concludes that while proactive domestic and overseas source security measures receive appropriate fiscal emphasis, border and cargo security measures and the supporting research and development efforts do not.

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NUCLEAR TERRORISM: CALIBRATING FUNDING FOR DEFENSIVE PROGRAMS IN RESPONSE TO THE THREAT

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LIST OF ACRONYMS AND ABBREVIATIONS

ABM	Anti-Ballistic Missile
ASP	Advanced Spectroscopic Portal
CAARS	Cargo Advanced Automated Radiography Systems
CBRN	Chemical, Biological, Radiological, and Nuclear
COINTELPRO	Counterintelligence Program
CSI	Container Security Initiative
CTR	Cooperative Threat Reduction
DBT	Design Basis Threat
DoD	U.S. Department of Defense
DOE	U.S. Department of Energy
DHS	U.S. Department of Homeland Security
DOS	U.S. Department of State
DNDO	Domestic Nuclear Detection Office
DTRA	Defense Threat Reduction Agency
FSU	Former Soviet Union
FY	Fiscal Year
GAO	Government Accountability Office
GCC	Gulf Cooperation Council
GTRI	Global Threat Reduction Initiative
HEU	Highly Enriched Uranium
IAEA	International Atomic Energy Agency
IC	Intelligence Community

IPFM	International Panel on Fissile Materials
LEU	Low Enriched Uranium
MOX	Mixed Oxide
MPC&A	Material Protection, Control, and Accountability
NEST	Nuclear Emergency Support Team
NIE	National Intelligence Estimate
NIPP	National Infrastructure Protection Plan
NNSA	National Nuclear Security Agency
ODNI	Office of the Director of National Intelligence
PPI	Proliferation Prevention Initiative
PSI	Proliferation Security Initiative
RDD	Radiological Dispersal Device
RDT&E	Research, Development, Test, and Evaluation
Rosatom	Russian State Nuclear Corporation
SLD	Second Line of Defense
USSTRATCOM	U.S. Strategic Command
WMD	Weapons of Mass Destruction

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This thesis is dedicated to my Explosive Ordnance Disposal (EOD) brothers and sisters that have fallen in combat while serving in Iraq and Afghanistan and the many others that have endured serious injury. Their bravery has made an immeasurable difference in ensuring the safety of others and their sacrifice will not be forgotten.

EOD-Initial Success or Total Failure!

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I. INTRODUCTION

A. BACKGROUND

A nuclear bomb in the hands of terrorists poses a grave risk in terms of their unpredictable willingness to use it and its capacity to cause massive destruction in a single instant. Concern also resonates that terrorists might use a nuclear bomb to destabilize international security or gain valuable leverage in the pursuit of political objectives.[1] Furthermore, the use or substantiated threat of such a weapon would likely escalate anti-terrorism expenditures that have already grown beyond sustainable levels.[2] Accordingly, many experts view the threat of a terrorist nuclear attack as one of the most urgent issues facing the Obama Administration.[3]

Prominent political figures within the U.S. government and numerous scholars depict the threat of a terrorist nuclear attack as grave, immediate, and one of the nation's highest defensive priorities.[4] Consequently, the threat of a terrorist nuclear attack elicits significant public and political concern. The U.S. government faces the challenge of composing strategies and policies responsive to this threat but not solely predicated on its potential consequences. Fear-based planning following 9/11 has led to an unsustainable

[1] Office of the Director of National Intelligence, *Annual Threat Assessment of the Intelligence Community for the Senate Select Committee on Intelligence, SSCI ATA Feb 2009* (Washington D.C.: Office of the Director of National Intelligence, 2009), 18.

[2] Ian S. Lustick, *Trapped in the War on Terror* (Philadelphia: University of Pennsylvania Press, 2006), 71.

[3] For the purposes of this research, a nuclear attack is defined as one resulting in a nuclear-yield producing detonation, Matthew Bunn and Andrew Newman, "Preventing Nuclear Terrorism, An Agenda for the Next President," Cambridge, Mass., and Washington, D.C.: Project on Managing the Atom, Harvard University and, Nuclear Threat Initiative, November 2008, http://belfercenter.ksg.harvard.edu/files/uploads/Preventing_Nuclear_Terrorism-An_Agenda.pdf, 1.

[4] For examples see Mowatt-Larssen, "The Growing Threat of Nuclear Terrorism," (paper presented at the March 31, 2009 IAEA conference) http://www-pub.iaea.org/MTCD/Meetings/PDFplus/2009/cn166/CN166_Presentations/Session%203/INV-13%20Mowat-Larsen.pdf, and Barack Obama, "Obama Prague Speech on Nuclear Weapons: Full Text," *The Huffington Post*, April 5, 2005, http://www.huffingtonpost.com/2009/04/05/obama-prague-speech-on-nu_n_183219.html, and The White House, "NSPD-17/HSPD 4 National Strategy to Combat Weapons of Mass Destruction, December 2002," Federation of American Scientists, http://www.fas.org/irp/offdocs/nspd/nspd-17.html.

level of investment in an attempt to remedy all risks.[5] The only way to reverse this trend is through the systematic and rational evaluation of threats to gauge the most effective application of national resources toward preventive measures.

Following the collapse of the Soviet Union in December 1991 and again after 9/11, the U.S. implemented a broad array of measures to address the risk of a nuclear terrorist attack. Many of these efforts remain dispersed across numerous cabinet level departments without the guidance of a central, fully empowered leadership position.[6] A resulting complication in implementing U.S. strategy involves the informal integration of efforts between the Departments of Energy, Defense, State, and Homeland Security. One of the most difficult challenges in determining the effectiveness of any or all of these programs lies in the lack of any standardized, comprehensive, or coherent measures of success. The disparate implementation of often-overlapping efforts and budgets creates conflicting reporting methodologies without producing any consolidated evaluation of security improvement. This fragmented approach may create the possibility for terrorists to exploit gaps in U.S. and international efforts to control the access, movement, and use of nuclear weapons and fissile materials.

The Security and Accountability For Every (SAFE) Port Act of 2006 required the Department of Homeland Security's Domestic Nuclear Detection Office (DNDO) to develop a Global Nuclear Detection Architecture (Table 1.). This effort seeks to integrate 74 federal programs involved in the prevention of nuclear terrorism both within the U.S. and abroad.[7] The vaguely worded legislation that created the architecture loosely mandates coordination between the Departments of Homeland Security, Energy, State, Defense, and numerous other agencies but fails to delineate how this should be accomplished.

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[5] Ian Lustick, *Trapped in the War on Terror* , 3.

[6] U.S. Government Accountability Office, *Nuclear Detection, Preliminary Observations on the Domestic Nuclear Detection Office's Efforts to Develop A Global Nuclear Detection Architecture, GAO-08-999T* (Washington D.C.: U.S. Government Accountability Office, 2008), 1–4.

[7] Ibid.

Layers	Sub-Layers	Examples
Exterior	Foreign Origin	Foreign sites with nuclear material that could be misused
Exterior	Foreign Transit	Illicit trafficking of nuclear material within the exterior layer
Exterior / Border	Foreign Departure	Foreign seaport with cargo containers destined for the U.S.
Exterior / Border	Transit to U.S.	Ships transporting cargo from overseas to the U.S.
Border	U.S. Border	Official U.S. ports of entry and between official land and sea ports of entry
Interior	U.S. Origin	Hospital with nuclear medicine equipment, or industrial site
Interior	U.S. Regional	Areas surrounding origins of nuclear material in the U.S.
Interior	Target Vicinity	Areas surrounding potential targets of nuclear attack
Interior	Target	Potential locations of nuclear attack within the U.S.

Table 1. Layers of the Global Nuclear Detection Architecture.[8]

This architectural depiction illustrates the expansive nature of the U.S. effort to prevent acts of nuclear terrorism. The overall size and scope of this undertaking is significant, receiving a combined appropriation of $2.8 billion in fiscal year (FY) 2007.[9] A core element of the U.S. strategy to counter terrorists' use of weapons of mass destruction (WMD) seeks to limit their ability to acquire fissile materials. However, fiscal, political, and diplomatic emphasis may not reflect the urgency or relative

[8] U.S. Department of Homeland Security, "DHS' Domestic Nuclear Detection Office Progress in Integrating Detection Capabilities and Response Protocols OIG-08-19," U.S. Department of Homeland Security, Office of Inspector General, http://www.dhs.gov/xoig/assets/mgmtrpts/OIG_08-19_Dec07.pdf , 10.

[9] U.S. Government Accountability Office, GAO-08-999T, 2008, 1–4.

importance of this strategic pillar. Further complicating matters, global networks, unbalanced regional security, uncooperative state actors and technological advances serve to undermine this effort. Without proper emphasis and funding, vulnerable materials and expanding proliferation may increase the ability of terrorists to steal, buy, or otherwise obtain fissile materials and carry out a nuclear attack. During FY 2007, only $473 million was made available to fund projects to secure, reprocess, or destroy nuclear weapons and fissile materials at their sources.[10] To mitigate the threat of terrorists conducting a domestic nuclear attack, the U.S. may be disproportionately emphasizing internal and border security programs while programs focused on securing foreign nuclear weapons and materials at their sources might offer more substantial and quantifiable security benefits.

The U.S. government should approach the threat of terrorists acquiring fissile materials with a coherent implementation strategy, not as an ad hoc compilation of additional departmental duties. Clearly, the U.S. government cannot protect everyone from everything at all times. U.S. efforts to prevent acts of terrorism are constrained by national fiscal limitations that may tighten under contemporary economic conditions.[11] To achieve the greatest degree of safety and security, policy makers must calibrate effective responses against a realistic threat assessment to make the most of declining fiscal resources. Without this judicious effort, areas in need of increased security measures may not receive adequate or timely attention.[12]

B. RESEARCH QUESTION

In an attempt to prevent future terrorist attacks, U.S. government officials and scholars have analyzed and compared numerous risks to determine the best allocation of

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10 William Tobey, "Testimony on the 'FY 2008 Budget Request for the NNSA's Office of Defense Nuclear Nonproliferation' before the House Appropriations Energy and Water Subcommittee," National Nuclear Security Administration (March 22, 2007), http://nnsa.energy.gov/news/1226.htm.

11 Ian Lustick, *Trapped in the War on Terror,* 71.

12 Ibid., 72.

resources. To prevent a terrorist nuclear attack, many politicians and scholars agree that securing nuclear weapons and fissile materials at their sources represents the first and best "line of defense."[13]

The general threat of a nuclear terrorist attack includes many possibilities: the attack of a nuclear facility, the dissemination of nuclear materials via a Radiological Dispersal Device (RDD), the use of a state-produced nuclear bomb, or the non-state fabrication and use of a yield-producing bomb. Of these threats, a detonation resulting in a nuclear yield would produce the most grave and immediate consequences. Despite significant attention, numerous sources of fissionable material remain dangerously vulnerable.[14] Furthermore, current geopolitical events may increase the potential for terrorists to acquire fissionable material. New states are pursuing uranium enrichment and plutonium separation while others are showing interest in expanding nuclear power production programs. Each avenue poses risks for increasing the availability of fissile materials. Global economic conditions and the evolution of terrorist sponsorship, tactics, and objectives may also contribute to the threat of terrorists acquiring fissile materials.

Some suggest the current interagency distribution of funds and ranking of priorities may not adequately focus on the source security of fissile material.[15] The U.S. spends billions of dollars annually to prevent acts of nuclear terrorism. The U.S. National Strategy to Combat Weapons of Mass Destruction depicts a layered system of preventive measures ranging from securing materials at foreign sources to interdicting terrorists with weapons or nuclear materials at border crossings, ports, and within the U.S. Several departments within the U.S. government manage these preventive programs independently. The 2009 appointment of Gary Samore as the WMD czar may provide a cross-departmental perspective to aid in determining where additional funds could

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[13] Matthew Bunn, *Securing the Bomb 2008*, (Cambridge, Mass.: Harvard University, 2008) http://www.nti.org/securingthebomb, v.

[14] Ibid.

[15] For examples see Bunn, xi, and, Graham Allison, *Nuclear Terrorism: The Ultimate Preventable Catastrophe* (New York: Henry Holt and Company, 2004), 140, and, Jospeh Cirincione, *Bomb Scare* (New York: Columbia University Press, 2007), 140.

provide the greatest impact.[16] However, without budgetary or staffing authority, the WMD czar will be unable to forcibly direct the integration of these programs and distribution of resources from an overarching vantage point.[17]

Through a comparative assessment of the U.S. programs that seek to prevent a nuclear terrorist attack and analysis of the threat of such an attack, this research answers three questions:

Can a cross-departmental review of current preventive programs budgets, progress, and effectiveness reveal areas where a greater degree of security could be achieved per dollar invested?

Are specific aspects of the terrorist nuclear threat better suited for targeting by preventive programs?

Are the funding and focus of U.S. efforts to prevent acts of nuclear terrorism consistent with the most urgent and likely threats? If not, what policy recommendations can be developed from a comparative analysis of current preventive programs and threats to better calibrate U.S. protective measures in order to achieve a greater degree of domestic security?

C. LITERATURE REVIEW

> In Western capitals today there are quiet people, serious people, who, while recognizing the low probability of such an attack, nonetheless worry that the successful use of just a single atomic bomb could bring the established order to its knees—or lay it out flat.[18]

1. Political and Scholarly Perception of the Threat of Nuclear Terrorism

The thought of a terrorist attack using a nuclear weapon evokes a sense of extreme vulnerability and fear in most people. The instantaneous destruction caused by a

[16] The White House, 2002, 4-6, and Bunn, 124.

[17] Ibid.

[18] William Langewiesche, *The Atomic Bazaar: Dispatches from the Underground World of Nuclear Trafficking* (New York: Farrar, Straus and Giroux, 2007), 19.

nuclear detonation in a major U.S. city provokes an incomparable image of chaos and destruction. A ten-kiloton nuclear bomb blast in virtually any major U.S. city would result in hundreds of thousands of deaths and a 1.5-mile circle of complete destruction.[19]

Many prominent scholars agree that the likelihood of a terrorist nuclear attack is significant and possibly imminent. Graham Allison explains "on the current path, a nuclear terrorist attack on America in the decade ahead is more likely than not."[20] Literature from the Monterey Institute's Center for Nonproliferation Studies explains the threat of nuclear terrorism "…looms larger today than ever before."[21] These well-qualified sources clearly support the contention that a nuclear terrorist attack against the U.S. may occur in the not too distant future.

Similarly, many significant governmental figures support this judgment. Retired General Eugene Habiger, the former Commander of USSTRATCOM and leader of the Department of Energy's anti-terror program until 2001, described the threat of nuclear terrorism by stating "it is not a matter of if; it's a matter of when."[22] Nuclear Emergency Support Team (NEST) veteran Alan Mode echoed this sentiment.[23] Likewise, when Secretary of Homeland Security Tom Ridge was asked what keeps him awake at night, his answer was "nuclear."[24] This concern remains a very prominent issue within the current U.S. administration as well. President Obama, in Prague, recently stated:

> …we must ensure that terrorists never acquire a nuclear weapon. This is the most immediate and extreme threat to global security. One terrorist with one nuclear weapon could unleash massive destruction. Al Qaeda has said it seeks a bomb and that it would have no problem with using it.

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[19] Allison, 1–4.

[20] Ibid, 14–15.

[21] Charles D. Ferguson and William C. Potter, *The Four Faces of Nuclear Terrorism* (Monterey, CA: Center for Nonproliferation Studies, 2004), 1.

[22] Allison, 6.

[23] Jeffrey T. Richelson, *Defusing Armageddon, Inside NEST, America's Secret Nuclear Bomb Squad* (New York: W.W. Norton & Company, Inc., 2009), 144.

[24] Allison, 6.

> And we know that there is unsecured nuclear material across the globe. To protect our people, we must act with a sense of purpose without delay.[25]

These statements convey the broad governmental assertion that the threat of nuclear terrorism is disturbingly likely and worthy of the utmost preventive attention to ensure that terrorists do not acquire a nuclear weapon or the materials to build one. While the consequences of a terrorist nuclear attack attract significant political attention, the application of preventive efforts must also weigh the threat, including both the intent and the capability to successfully carry out an attack.[26]

2. The Risk of a Terrorist Nuclear Attack

The potential for a nuclear bomb to cause massive destruction is not debatable. However, the likelihood of such an attack raises three fundamental questions that must be answered to fairly and rationally characterize the scope of the threat: 1) Do terrorists intend to acquire a nuclear weapon? 2) How do they intend to use it? 3) Do they have the ability to carry out such an attack?[27]

Al Qaeda's efforts to procure a bomb and Osama bin Laden's stated desire to use one clearly demonstrate intent.[28] Similarly, Aum Shinrikyo's use of chemical and biological weapons coupled with its pursuit of a nuclear weapon strongly suggests their intentions for use against the general population in the pursuit of political and ideological objectives.[29] While only a few terrorist organizations have expressed nuclear ambitions, the potential consequences of even a single successful attack demand further evaluation of the threat.

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[25] Obama.

[26] Willis, et al., 6–9.

[27] Henry H. Willis et al., Estimating *Terrorism Risk* (Arlington, Virginia: RAND Corporation, 2005) 6.

[28] Jason Pate and Gary Ackerman, "Assessing the Threat of WMD Terrorism," James Martin Center for Nonproliferation Studies, CNS Reports (2001), http://cns.miis.edu/pubs/reports/wmdt.htm.

[29] Jeffrey T. Richelson, *Defusing Armageddon, Inside NEST, America's Secret Nuclear Bomb Squad* (New York: W.W. Norton & Company, Inc., 2009), 123-128 and Jonathan B. Tucker, "Chemical Terrorism: Assessing Threats and Responses," in *Weapons of Mass Destruction and Terrorism*, ed. Howard and Forest (Columbus: McGraw-Hill, 2008), 214–215.

In the 2009 Annual Threat Assessment, Director of National Intelligence Dennis Blair provided the Intelligence Community's assessment that al Qaeda continues to pursue plans for attacks against the U.S. homeland, "focusing on prominent political, economic, and infrastructure targets designed to produce mass casualties and visually dramatic destruction."[30] Currently, al Qaeda is the only terrorist group assessed to actively harbor intentions for a nuclear attack against the U.S.[31] The 9/11 Commission Report notes that in 1995 Osama Bin Laden attempted to purchase highly enriched uranium (HEU) through a Sudanese military officer for $1.5 million.[32] While the material did not turn out to be HEU, the event confirmed Bin Laden's interest in pursuing a nuclear capability. Aum Shinrikyo, with a membership of over 50,000 and financial resources exceeding one billion dollars, attempted to purchase nuclear weapons and fissile materials through Russian sources.[33] When these efforts failed, the group purchased property in Australia known to contain uranium deposits.[34] Clearly, some terrorist organizations have demonstrated the intent to pursue nuclear weapons. However, the capability to carry out an attack must also be examined to provide the other half of the threat depiction.

The capability to execute such an attack includes acquiring a complete nuclear warhead or an adequate quantity of fissile material, as well as the scientific, technical, and financial resources for building, transporting, and detonating a bomb. Clearly, if terrorists are unable to obtain a bomb or the fissile material, the remaining requirements become irrelevant. Difficulties in production, purchase, and theft coupled with the comparative ease of acquiring other weapons have undoubtedly played a key role in

[30] Office of the Director of National Intelligence, 6.

[31] Bob Graham et al., *World at Risk, The Report of the Commission on the Prevention of WMD Proliferation and Terrorism* (New York: Vintage Books, 2008), 20.

[32] 9-11 Commission, *The 9/11 Commission Report: Final Report of the National Commission on Terrorist Attacks Upon the United States -- Authorized Edition* (New York: W.W. Norton & Company, 2004) 60–61.

[33] Richelson 2009, 123–126.

[34] Allison, 41–42.

discouraging and preventing terrorists from acquiring nuclear warheads or fissile materials. Despite these hurdles, the expanding use of nuclear technology will continue to present new acquisition opportunities.

Abundant, peaceful nuclear energy production programs can potentially be used to justify uranium enrichment or become a source for clandestinely reprocessed plutonium. Either case represents another potential source of fissile material beyond those of purchase or theft. In February 2007, a delegation from the Gulf Cooperation Council (GCC) met with the International Atomic Energy Agency (IAEA) to discuss pursuing a feasibility study for a nuclear power program. Egypt, Saudi Arabia, Syria, and Jordan are each considered potential candidates to pursue nuclear power and possibly weapons, especially in light of Iran's indeterminate nuclear ambitions.[35] Similarly, many of the countries of Northeast Asia have the technical prerequisites to produce nuclear weapons and possibly increasing motivation due to North Korea's weapons production.[36]

Terrorists' ability to carry out a nuclear attack rest largely on their capacity to acquire either a functional nuclear bomb or the materials to fabricate one.[37] To date, many authors agree the start-to-finish production of a nuclear weapon requires the resources and determination of a state.[38] An independent nuclear weapons program requires the support of an extensive and modern industrial complex, a staff of qualified scientists and other highly technical specialists, a secure environment to conduct a long-term production effort, and a financial commitment of billions of dollars per year.[39] Due to these prohibitive weapon construction requirements, terrorists would likely attempt to acquire a complete nuclear weapon through a state sponsored transfer or theft.

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[35] Dalia Dassa Kaye and Frederic M. Wehrey, "A Nuclear Iran: The Reactions of Neighbors," *Survival* 49:2, 111–128 (2007), http://pdfserve.informaworld.com/802152_731325979_779310491.pdf, 113.

[36] James Clay Moltz, "Future Nuclear Proliferation Scenarios in Northeast Asia," in *Nuclear Weapons Proliferation in the Next Decade,* ed. Peter R. Lavoy (New York: Routledge, 2008), 159–160.

[37] Stephen M.Younger, *The Bomb: A New History* (New York: Harper Collins Publishers, 2009), 146.

[38] See examples in Younger, 146 and Ferguson and Potter 34–36.

[39] Younger, 139–146.

The North Korean government has been directly implicated in trafficking narcotics, counterfeiting U.S. currency, and other criminal activity for over thirty years.[40] Former Secretary of Defense Donald Rumsfeld described North Korea as the world's "single largest proliferator of ballistic missiles."[41] As late as April 2006, the U.S. State Department still listed North Korea as a state-sponsor of terrorism due to its historic ties to terrorist activities.[42] Estimates suggest that before its nuclear test in 2006, North Korea likely had produced enough plutonium for 6 to 8 small nuclear bombs.[43] Current intelligence assessments of the North Korean nuclear program indicate the capacity to produce enough plutonium for one weapon annually and a uranium enrichment effort with a small but undetermined capacity.[44] Selling weapons or materials presents inherent supply- and demand-side difficulties. The slightly more transparent Pakistani program indicates that even a relatively small-scale weapons production program generates costs in the billions of dollars.[45] Based on production costs as well as cases of small amounts of fissile material offered for sale in the former Soviet Union (FSU) states, the black-market cost of a nuclear weapon would likely run into the hundreds of millions if not billions of dollars.[46] Despite numerous cases of sales and theft of fissile materials, there is no evidence that a complete weapon has ever been stolen or sold.[47]

While deterrence may not hold a significant degree of leverage against non-state or terrorist actors, the certainty of retribution against states typically does.[48] Advances in

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40 Balbina Y. Hwang, "Curtailing North Korea's Illicit Activities." *Heritage Foundation Backgrounder* #1679 (August 25, 2003), http://www.heritage.org/research/asiaandthepacific/bg1679.cfm, 3.

41 Hwang, 5.

42 U.S. Department of State, *Country Reports on Terrorism, Chapter 6 –State Sponsors of Terror Overview*, U.S. Department of State, Office of the Coordinator for Counterterrorism, http://www.state.gov/s/ct/rls/crt/2005/64337.htm.

43 Hecker, 4.

44 Ibid, 6–9.

45 Gordon Correra, *Shopping for Bombs: Nuclear Proliferation, Global Insecurity, and the Rise and Fall of the A.Q. Khan Network* (New York: Oxford University Press, 2006), 11.

46 Richelson 2009, 126.

47 Robin M. Frost, "The Nuclear Black Market," *Adelphi Papers* 45 (2005), http://www.informaworld.com/smpp/content~db=all?content=10.1080/05679320500519005, 17.

48 Bunn and Newman, 1.

the forensic identification of nuclear materials make it increasingly possible if not likely that a nuclear attack would be quickly traced back to a state of origin.[49] In 2001, the Department of Defense concluded that it was unlikely that any state would willingly transfer a nuclear weapon to a non-state actor.[50]

If terrorists are unable to procure a complete nuclear bomb, they still may attempt to purchase or steal enough fissile material to construct their own. While bomb construction and delivery pose significant difficulties, acquisition of the fissile material is widely regarded as the most significant hurdle.[51] Due to the complexity involved with uranium enrichment or plutonium separation, terrorists would most likely acquire weapons-grade fissile materials through a state-sponsor or theft.[52] Stephen Younger, former director of the Defense Threat Reduction Agency (DTRA), explains that one must acquire a sufficient quantity of weapons-grade uranium (U-235) or plutonium (P-239) to build a yield-producing bomb.[53] IAEA documents explain that an actual nuclear bomb could be fabricated from as little as 25 kilograms of HEU or 8 kilograms of plutonium.[54]

The IAEA reports that between 1993 and 2003 there were 540 confirmed cases of illicit trafficking in nuclear materials.[55] Russia is frequently cited as one of the most likely sources for terrorists to steal or purchase nuclear materials. Russia may currently possess as many as 16,000 nuclear weapons and hundreds of storage facilities housing weapons-grade plutonium and uranium.[56] Numerous works also suggest that Russian nuclear custodians may be susceptible to bribery due to low wages, economic instability,

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[49] Langewiesche, 20.

[50] Ferguson and Potter, 57.

[51] Younger, 118.

[52] Bob Graham et al., 20.

[53] Younger, 140.

[54] U.S. Government Accountability Office, *Preventing Nuclear Smuggling GAO-05-375.* (Washington D.C.: U.S. Government Accountability Office, 2005), 1.

[55] Ibid.

[56] Joseph Cirincione, Jon B. Wolfsthal, and Miriam Rajkumar, *Deadly Arsenals, Nuclear, Biological, and Chemical Threats* (Washington D.C.: Carnegie Endowment for International Peace, 2005), 121–131.

and a culture where corruption is often tolerated.[57] Despite considerable progress over the past 15 years in securing the Russian nuclear stockpile, accountability and security concerns remain.[58]

In contrast to this grim assessment, other prominent authors point out that the early 1990s represented the period where weapons and materials were most vulnerable. If weapons or significant amounts of fissile material were sold or stolen, where have they gone and why have they not been used?[59] Despite dozens of interdicted sales of minute quantities of fissile materials, there is no evidence of there ever being a sale or transfer of a significant quantity to a terrorist or any other party.[60] The extended historical absence of terrorists acquiring nuclear weapons or a significant quantity of fissile material presents a strong argument that current mitigating efforts may be balanced appropriately and operating effectively.

After acquiring the requisite material, terrorists would face the challenge of constructing a nuclear device capable of achieving the necessary chain-reaction.[61] Implosion designs require significant technical expertise to construct and are considered much more sophisticated. In contrast, HEU, gun-type weapons are generally regarded to be relatively simply to construct and the likely choice of material and design for terrorist.[62] Collectively, the challenge of acquiring the necessary materials, constructing an operable weapon, and transporting it to a target present enormous and costly challenges and numerous opportunities for discovery and interdiction.

3. U.S. Strategy and Preventive Programs

The 2009 White House Homeland Security Agenda lists 12 strategic goals directed toward preventing nuclear terrorism. The first goal listed is to “Secure Nuclear

[57] Ferguson and Potter, 58–59.

[58] Cirincione, Wolfsthal, and Rajkumar, 132.

[59] Frost, 17.

[60] Ibid.

[61] Younger, 144.

[62] Allison, 95–98.

Weapons Materials in Four Years and End Nuclear Smuggling."[63] The U.S. strategy for countering nuclear smuggling is comprised of a complex system of efforts directed toward the ultimate goal of "keeping the world's most dangerous weapons out of the hands of the world's most dangerous people."[64] The U.S. National Strategy to Combat Weapons of Mass Destruction provides specific counter-proliferation and non-proliferation functions creating a layered defensive framework to prevent nuclear trafficking and terrorism.[65] Counter-proliferation measures are taken to prevent the undesired production, transfer, movement or storage of nuclear materials or technology. Military, intelligence, technical, and law enforcement communities across several U.S. governmental entities provide the structure for this exceedingly difficult task.[66] Non-proliferation programs seek to control the production, supply and storage of nuclear weapons related materials and technology through the implementation of multilateral arms control treaties, export controls, and other related agreements or sanctions. The counter-proliferation and non-proliferation strategic pillars are integrated through the enabling functions of intelligence collection and analysis, research and development, strengthened international cooperation, and targeted strategies against proliferators.[67]

The U.S. leads and participates in many international efforts to control fissile material production, storage and trafficking. The DoD Cooperative Threat Reduction (CTR) program seeks to dismantle, consolidate, and secure the enormous quantities of FSU weapons of mass destruction materials and more recently, such materials in other countries as well.[68]

The Department of Energy's, Material Protection, Control, and Accounting (MPC&A) program represents a multifaceted approach toward enhancing the security of

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63 The White House, "Homeland Security and Counterterrorism, 2009" The White House, Issues, 2009 http://www.whitehouse.gov/agenda/homeland_security/.

64 National Security Council, "The National Security Strategy, March 2006" The White House. http://www.whitehouse.gov/nsc/nss/2006/.

65 The White House, 2002, 4–6.

66 Ibid.

67 Ibid.

68 Defense Threat Reduction Agency, "Cooperative Threat Reduction," DTRA Programs Web site, http://www.dtra.mil/oe/ctr/programs/index.cfm.

nuclear materials in the former Soviet Union states, China, Pakistan and India.[69] This program is comprised of wide ranging efforts to upgrade the security of storage facilities and increase cooperative accountability measures. MPC&A represents one of the largest and most successful efforts undertaken to increase the security of overseas nuclear warheads and fissile material.

The Megaports Initiative is a component of the Department of Energy's (DOE) Second Line of Defense (SLD). This effort increases the capability to detect and deter smuggling of radioactive materials across international borders.[70] Following the 9/11 attacks, concerns grew that terrorists could smuggle a nuclear device into the country. While nuclear material could be transported in luggage, cars, freight, mail, or other means, some avenues represent a larger proportional vulnerability. The U.S. annually receives over nine million shipping containers through its seaports alone.[71] In 2003, DOE began deploying radiation detection monitors in conjunction with its Megaports Initiative.[72] Under the Megaports Initiative, the National Nuclear Security Administration (NNSA) collaborates with foreign governments to prevent the smuggling of dangerous nuclear materials.[73] While this effort began in 2003, as of 2008, only 19 of 75 targeted ports had been completed.[74] A 2005 Government Accountability Office (GAO) report voices concern that DOE "does not have a comprehensive long term plan to guide the Initiative's efforts."[75] The report goes on to indicate that funding shortfalls, technical challenges with detection equipment, and gaining the cooperation of foreign governments all pose additional operational and technical challenges.[76] Possibly the

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[69] Bunn, 117.

[70] U.S. Government Accountability Office, GAO-05-375, 2005, 6.

[71] U.S. Department of Justice, "Drug Trafficking in the United States," U.S. Drug Enforcement Administration, http://www.usdoj.gov/dea/pubs/state_factsheets.html.

[72] U.S. Government Accountability Office, GAO-05-375, 2005, 6–8.

[73] U.S. Department of Energy, "Nuclear Nonproliferation, Megaports Initiative," National Nuclear Security Administration, http://nnsa.energy.gov/nuclear_nonproliferation/1641.htm.

[74] Ibid.

[75] U.S. Government Accountability Office, GAO-05-375, 2005, 1.

[76] Ibid.

most disconcerting information in the report discusses the ease of using shielding materials, such as lead, to completely negate the fielded detection capability.[77]

While not a funded element of the Global Nuclear Detection Architecture, the Proliferation Security Initiative (PSI) launched on 31 May 2003, represents a cooperative global effort to stop the trafficking of WMD.[78] Currently supported by more than 90 nations, the plan encourages member states to increase searches and seizures of suspected WMD shipments and share information that may aid other member states in their efforts.[79] This program is unique in that it has no formal structure and receives no dedicated funding but, due to its strong international support, may hold significant potential in deterring or detecting and interdicting the movement of WMD materials.

The absence of a terrorist nuclear attack and the expansive reach of these programs may suggest a well-formulated plan directed toward securing fissile materials and preventing illicit trafficking. However, many argue that these measures fail to direct sufficient resources toward overseas source security programs, or adequately account for the fluid nature of the threat and porous U.S. border and cargo security measures.[80] The GAO has also been critical of a lack of centralized direction and any comprehensive plan to integrate the numerous disjointed nuclear security efforts.[81]

4. Conclusion

This literature review provided a survey of the political and scholarly opinions regarding the prospect of a terrorist nuclear attack. Furthermore, it framed the threat of terrorists acquiring or building a yield-producing nuclear bomb by including perspectives on both the terrorist actor's intent and requisite capabilities to successfully execute such an attack. A broad discussion of U.S. strategy and several programs designed to prevent

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77 U.S. Government Accountability Office, GAO-05-375, 2005, 6.

78 U.S. Department of State, "Proliferation Security Initiative," U.S. Department of State, Under Secretary for Arms Control and International Security, http://www.state.gov/t/isn/c10390.htm.

79 Hwang, 5.

80 Graham et al., xxi.

81 U.S. Government Accountability Office, GAO-08-999T, 2008, 1–4.

a terrorist nuclear attack provided an indication of the wide-ranging scope of threat response measures. Further analysis will reveal specific areas where security programs are not funded or prioritized to maximize their utility in preventing terrorists from acquiring or using fissile material to carry out an attack. This analysis will provide opportunities to apply resources and strategic emphasis toward more productive threat reduction measures.

D. METHODOLOGY AND OUTLINE

This study begins with an analysis of the primary threat response programs including a survey of the funding, current implementation, remaining gaps, and ease of circumvention. This research utilizes a qualitative comparison to establish current performance and opportunities for incremental security improvement. The next building in this study encompasses the threat. This section focuses on the capability of a terrorist actor to acquire a nuclear weapon or quantity of fissile material necessary to build a yield-producing bomb and transport the materials to a target within the U.S. This analysis includes a survey of potential sources of foreign and domestic nuclear weapons and fissile material by terrorists as well as emerging geopolitical conditions that may increase material availability in the near future.

This research compares the budgets and relative effectiveness of the primary U.S. programs to prevent acts of nuclear terrorism against the most serious threats of a terrorist nuclear attack within the U.S. This comparative analysis bridges departmental lanes of responsibility to provide a holistic perspective and identify programs in need of additional resources as well as efforts where additional resources offer proportionately little added security. Ultimately, this research determines how the funding and focus of major U.S. programs to prevent acts of nuclear terrorism could be more efficiently calibrated against the most urgent and likely threats and where opportunities for improvement exist.

In order to accomplish this objective, Chapter II provides analysis of the primary U.S. programs to mitigate acts of nuclear terrorism. This study focuses on U.S. nuclear security programmatic funding and effectiveness for specific measures of the Global

Nuclear Detection Architecture to provide a threat response perspective and proportional depiction of where emphasis is currently placed and where it is lacking.

Chapter III explores potential avenues and opportunities for a terrorist to acquire, transport and employ a nuclear bomb. Based on a survey of the locations and quantities of fissile materials, modes and methods of transportation, and weaponization options, this research develops a threat prioritization to identify focal areas where preventive measures should receive heightened emphasis.

Chapter IV provides a comparative analysis of the findings in Chapters II and III. This analysis develops the rationale to support programmatic prioritization and funding adjustments among the array of U.S. preventive programs currently in place.

Chapter V provides the primary conclusions based upon the research findings and offers policy recommendations at the programmatic and strategic levels.

II. PRIORITIZING THE EFFECTIVENESS OF MAJOR U.S. PROGRAMS TO PREVENT ACTS OF NUCLEAR TERRORISM

Historical examples of various types of illicit trafficking and simple logic suggest that as fissile materials disperse from their sources into grey and black markets or the hands of terrorists they become increasingly difficult to track and interdict. As a result, the notion of securing all fissile materials at their sources, with suitable and verifiable protective measures, is considered by most experts to offer the greatest potential for reducing the threat of a terrorist nuclear attack.[82] Senator Nunn, one of the CTR program's architects and largest proponents, views source security as somewhat of a panacea that if comprehensively implemented could virtually eliminate the threat of nuclear terrorism.[83] Unfortunately, significant obstacles stand in the way of fully reaching this illusive and deceptively promising end-state. Incomplete identification of sources, inaccurate accounting of fissile material, and states unwilling to cooperate with U.S. efforts pose difficult challenges in effecting a comprehensive source security system. Acknowledging these realities, the U.S. National Strategy to Combat Weapons of Mass Destruction employs counter-proliferation and nonproliferation functional pillars that create a complex, layered, defensive framework to prevent nuclear trafficking and terrorism.[84] While the measurable effectiveness of each programmatic component varies considerably and their integration is at times questionable, the historic absence of a terrorist nuclear attack suggests some measure of efficiency.

Through a series of overlapping threat response programs, the U.S. strategy seeks to incrementally increase the likelihood that a terrorist would be detected and caught before carrying out a nuclear attack. This strategic intent, framed within the Global Nuclear Detection Architecture, affords that no single measure should be exclusively relied upon. The Global Nuclear Detection Architecture includes programs to secure special nuclear and radiological materials at foreign sources and detect their movement

[82] For examples Bunn, v, Allison, 140 and Cirincione, 140–141.

[83] Cirincione, 141.

[84] The White House, 2002, 4–6.

through foreign ports and border crossings, the U.S. border, and inside the U.S. Within the Global Nuclear Detection Architecture's framework, the layers of defense are divided into three broad categories: foreign source and transit, the U.S. border, and U.S. interior security. The responsibility for implementing efforts to secure sources of nuclear weapons and fissile materials is divided between the Departments of Defense, Energy, State, and Homeland Security (Figure 1).

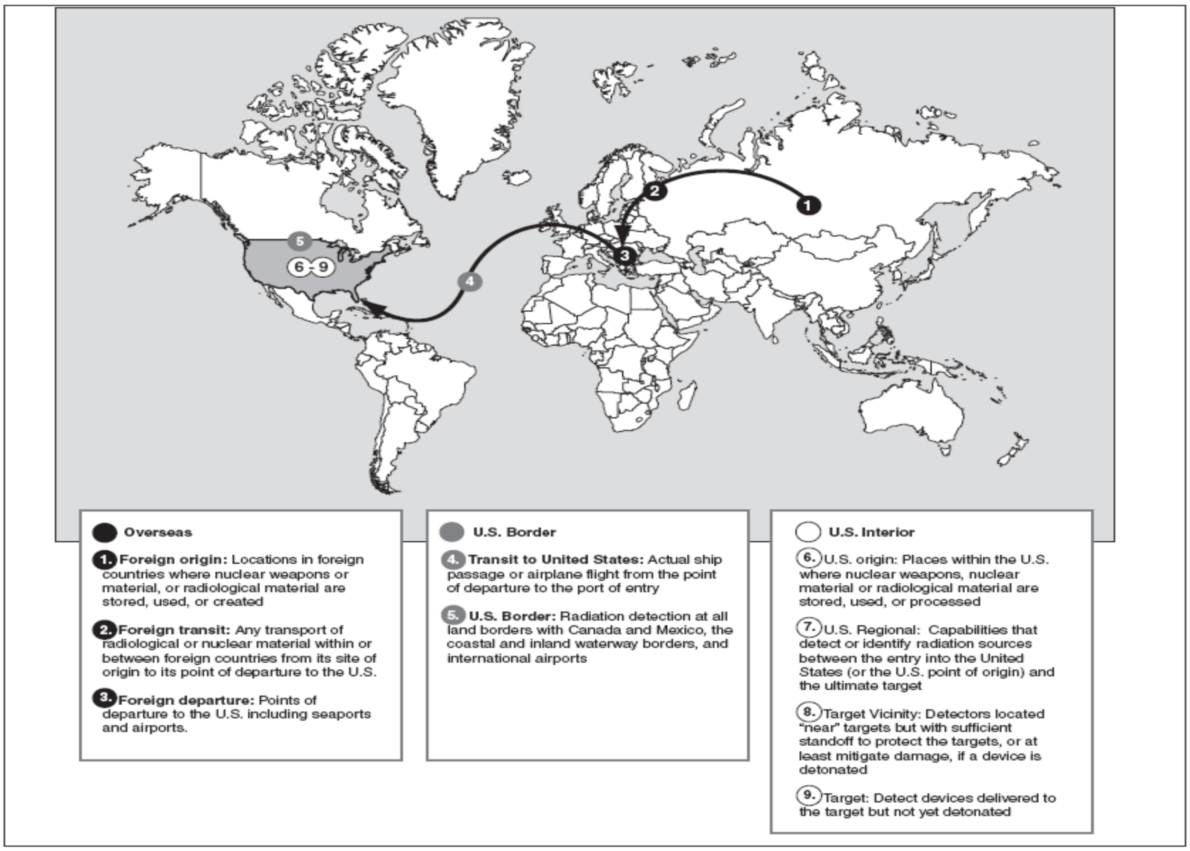

Figure 1. Geographic Depiction of the Global Nuclear Detection Architecture.[85]

The goal of this chapter is to determine which programs offer the greatest security return on investment and assess whether those programs currently receive funding consistent with their preventive potential. This chapter offers a qualitative assessment of

[85] U.S. Government Accountability Office, *Nuclear Detection: Domestic Nuclear Detection Office Should Improve Planning to Better Address Gaps and Vulnerabilities GAO-09-257*, Washington D.C. Government Accountability Office, January 2009, 10.

the major programs to prevent a nuclear terrorist attack by considering the funding, implementation, remaining gaps, and ease of circumvention. For the purposes of this research, the U.S. border and U.S. interior layers of the Global Nuclear Detection Architecture will be considered together, since an attack at a U.S. port, border crossing, or interior location would each represent an attack on the U.S. and bear indistinguishable national consequences. Ultimately, this chapter demonstrates that while foreign source security measures provide some of the most quantifiable security results, inconsistencies in their application and long-term reliability diminish their relative significance when compared to other efforts. Furthermore, diplomatic constraints prevent the application of additional resources from being freely applied toward overseas source security programs, whereas other defensive efforts could benefit significantly and immediately from additional funding.

A. OVERVIEW OF FISCAL YEAR 2007 PROGRAM BUDGETS AND FOCUS BY AGENCY[86]

Since 1992, the U.S. has allocated over $10 billion toward overseas programs to secure fissile material and prevent nuclear smuggling. Recently the U.S. committed to continue its support by providing an additional $10 billion over the next decade to pursue nonproliferation and threat reduction programs in Russia and other former Soviet states.[87]

In FY 2007, DOE, DoD, DHS, and DOS received combined appropriations for programs included in the global nuclear detection architecture totaling $2.8 billion (Figure 2 and Table 2).[88] Resources allocated for overseas efforts were roughly equivalent to that of U.S. border and domestic security programs, each receiving approximately $1.1 billion.[89] The remaining $577 million funded crosscutting programs generally applicable to both foreign and domestic activities including research and

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[86] FY07 Budgets are used because they represent the most current figures for which comprehensive statistics regarding programmatic effects have been made public.

[87] Amy F. Woolf, *Nonproliferation and Threat Reduction Assistance: U.S. Programs in the Former Soviet Union*-RL31957, Congressional Research Service, February 11, 2009 http://assets.opencrs.com/rpts/RL31957_20090211.pdf , 1.

[88] U.S. Government Accountability Office, GAO-09-257, January 2009, 25.

[89] Ibid.

development, training, and technical assistance programs. Among the four departments, DOE received the largest share of both the overseas and domestic appropriations at 66 and 76 percent, respectively.

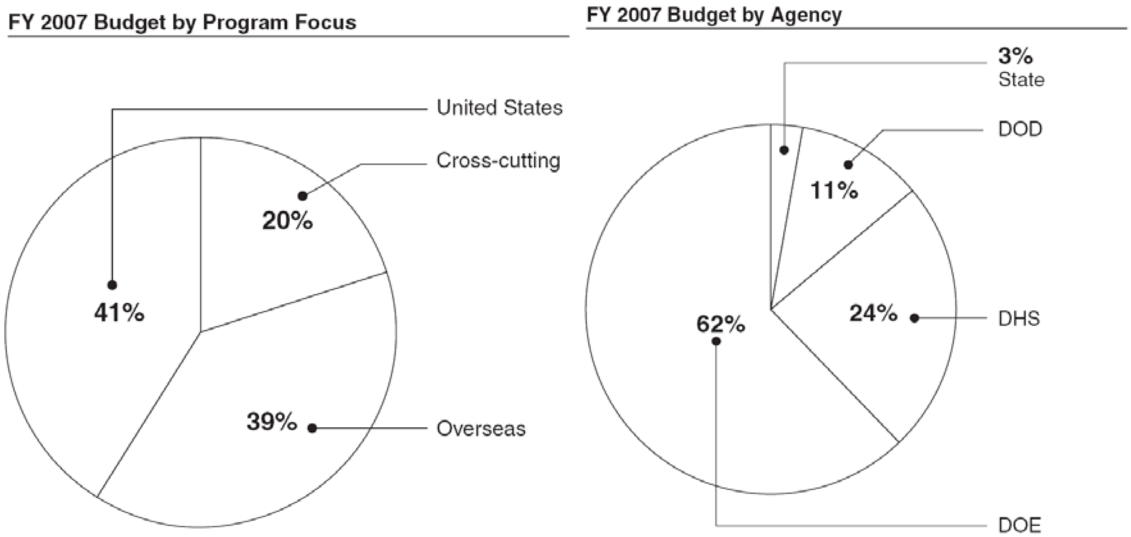

Figure 2. Percentages of FY07 Budget Applied to Secure Overseas Nuclear Materials and Prevent Smuggling, Secure Domestic Nuclear Materials and Detect Nuclear Materials at U.S. Borders and Ports of Entry, and Efforts That Cut Across Both Areas[90]

($ in millions)

Geographic Focus	DHS	DOD	DOE	State	Total
Overseas	139.77	161.90	736.74	81.13	1119.54
United States	274.65	1.60	871.49	0.00	1147.74
Cross-cutting	271.18	137.07	168.86	0.00	577.12
Total	685.60	300.57	1777.09	81.13	2844.39

Note: “United States” includes efforts at the U.S border as well as within the U.S. interior.

Table 2. Distribution of Global Nuclear Detection Architecture FY07 Budget for Securing and Detecting Radiological and Nuclear Weapons or Materials.[91]

90 U.S. Government Accountability Office, GAO-09-257, January 2009, 26.

91 Dana Shea, *The Global Nuclear Detection Architecture: Issues for Congress*-RL34574, Congressional Research Service, March 25, 2009 http://fas.org/sgp/crs/nuke/RL34574.pdf , 14.

B. OVERSEAS ORIGIN, TRANSIT AND DEPARTURE SECURITY

The U.S. considers many of the nuclear-armed states and other countries in possession of fissile material to maintain adequate safety, security, and accountability measures (such as France, Japan, and the United Kingdom). Others, such as North Korea and Iran, may not maintain acceptable transparency or security standards but will likely remain opposed to any direct U.S. involvement. In the center lie countries in need of and willing to accept security assistance, such as Russia and Kazakhstan. This international political landscape provides the boundaries within which U.S. security programs operate. Russia's relatively cooperative demeanor and possession of a vast percentage of the global supply of weapons and fissionable material, much of which was previously identified as being inadequately secured, creates a logical focal point where most U.S. funded overseas efforts are directed.

1. DoD Overseas Nuclear Security Programs

Following the collapse of the Soviet Union in 1991, the U.S. reacted quickly to address concerns regarding the safety and security of Soviet nuclear weapons and fissile material. With the passage of the "Soviet Nuclear Threat Reduction Act of 1991," also known as the Nunn-Lugar Amendment (P.L. 102-228), the U.S. began providing assistance to states of the former Soviet Union (FSU states that inherited strategic nuclear weapons include Russia, Belarus, Ukraine, and Kazakhstan) to transport, consolidate, secure, and dismantle nuclear weapons and delivery systems.[92] Initially Congress provided funds exclusively to DoD to conduct nuclear threat reduction assistance efforts. In 1993, the DoD created the "Cooperative Threat Reduction (CTR) program" title to describe these collective assistance efforts.[93] After the CTR program's inception, Congress began dispersing elements of the nuclear nonproliferation and threat reduction mission and budget among the DoD, DOE, DOS, and eventually DHS. Furthermore, these programs have broadened in scope beyond the initial nuclear focus to include biological and chemical threats, foreign and domestic border and port security, and a host

92 Woolf, 3.

93 Ibid., 4.

of other related initiatives. Although often misused, the CTR program title specifically refers to those programs undertaken by the DoD, while the phrase “threat reduction and nonproliferation assistance” refers to the collective efforts of the DoD, DOE, DHS and DOS.[94]

Of the CTR program’s five objective areas, only two specifically direct resources toward consolidating and securing nuclear weapons and fissile materials at their sources and in transit.[95] These two objective areas include the Nuclear Weapons Safety and Security program, the Nuclear Weapons Transportation Security program, and the Proliferation Prevention initiative [96] The remaining CTR objective areas involve strategic delivery systems, biological, and chemical weapon destruction, infrastructure dismantlement, and administrative tasks.[97]

a. The Nuclear Weapons Safety and Security Program

Operating on an FY08 budget of $102.5 million, the Nuclear Weapons Safety and Security program provides enhanced security at nuclear weapons and fissile material storage sites.[98] Using the DoD nuclear security standard as a model, the CTR program seeks to establish and maintain strict security at 42 permanent and five temporary nuclear weapon storage sites.[99] Currently the program sustains upgraded security measures at the five Ministry of Defense (12th Main Directorate) temporary rail transfer points. As of December 2007, 12 of the 42 permanent storage sites had received

94 Woolf, 4, and Andrew Newman and Matthew Bunn, “Funding for U.S. Efforts to Improve Controls Over Nuclear Weapons, Materials, and Expertise Overseas: A 2009 Update,” Cambridge, Mass.,: Project on Managing the Atom, Harvard University, and Nuclear Threat Initiative, June 2009, http://belfercenter.ksg.harvard.edu/files/2009_Nuclear_Budget_Final.pdf , 10.

95 U.S. Department of Defense, “Cooperative Threat Reduction Annual Report to Congress Fiscal Year 2009,” Defense Threat Reduction Agency, http://www.dtra.mil/documents/oe/ctr/FY09%20CTR%20Annual%20Report%20to%20Congress.pdf, 1.

96 U.S. Government Accountability Office, GAO-09-257, January 2009, 27.

97 U.S. Department of Defense, 2009, 1.

98 Office of the Secretary of Defense, “OSD RDT&E Budget Item Justification,” February 2008, http://www.dtic.mil/descriptivesum/Y2009/OSD/0605161D8Z.pdf, 4.

99 Woolf, 13. and U.S. Department of Defense, 2009, 13.

full upgrades, with an additional 12 scheduled for completion in December 2008.[100] Confirmation of the sites scheduled for completion in 2008 has not yet been published.

The ancillary Fissile Material Storage Facility project provides safe, secure, and centralized storage for weapons-grade fissile material and was completed and turned over to Russian control in December 2003.[101] Pending the successful conclusion of the bilateral Framework Agreement regarding transparency negotiations, the CTR program will continue to provide funding for monitoring assistance at the Mayak storage facility.[102] The Mayak facility's maximum storage capacity of 50 tons of plutonium and 200 tons of HEU (roughly equivalent to 25,000 nuclear warheads) make its security of paramount importance.[103]

The Nuclear Weapons Safety and Security program also encourages and offers assistance for the dismantlement of strategic nuclear weapons.[104] This facet of the CTR program has made remarkable progress, reducing the Russian nuclear stockpile by 7,260 warheads, 79 percent of the intended goal of 13,300.[105] This project is scheduled for completion in FY 2013.[106]

b. The Nuclear Weapons Transportation Security program

The CTR program also enhances Russian nuclear security by assisting with the transportation of 1,000 to 1,500 nuclear weapons annually.[107] This project provides security analysis, specially designed rail cars and associated security equipment to enable warhead shipment to dismantlement, or more secure, consolidated storage sites. In FY 2007, with a budget of $32.7 million, this subset of the CTR program supported 47

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100 U.S. Department of Defense, 2009, 13.

101 Ibid., 15.

102 Ibid.

103 Stockholm International Peace Research Institute, *SIPRI Yearbook 2007: Armaments, Disarmament and International Security* (CM Gruppen, Bromma, 2007) 515 and Woolf, 14.

104 Newman and Bunn, 10 and U.S. Department of Defense, 2009, 1–2.

105 U.S. Department of Defense, 2009, 1–2.

106 Ibid., 2.

107 Woolf, 11.

train shipments. It will continue to support an average of four shipments per month through FY 2012.[108] There are no guarantees that CTR supports every nuclear weapon shipment, but rather only those for which the Russians request assistance. As a result, there are no firm metrics depicting the percentage of weapons shipments that receive additional security through the CTR program in contrast to those receiving exclusively Russian security. However, based on consolidation and dismantlement plans and the 10,000–15,000 weapons remaining in the Russian inventory, the CTR program likely affects most if not all of the weapon shipments.[109]

c. The Proliferation Prevention Initiative (PPI)

The Proliferation Prevention Initiative provides assistance to non-Russian FSU countries to prevent smuggling of WMD or related materials across their borders. Currently, through the PPI, DoD provides assistance to Azerbaijan, Kazakhstan, Ukraine, and Uzbekistan.[110] The program includes both land border and maritime counter-smuggling measures, but has no long-term objective leading to a definitive end-state. Continued cooperation, the installation of additional radiation detection monitors and alarms, and the provision of logistical support and training represent the primary goals included in the CTR five-year plan.[111] This program received $32.4 million in FY07 with no firm data published regarding any quantifiable security enhancement.

2. DOE Overseas Nuclear Security Programs

Two programs accounted for nearly 81 percent of the FY07 DOE budget to secure foreign sources of fissile material.[112] With an overall budget of $736 million, the Materials Protection, Control, and Accounting (MPC&A) program accounted for $414 million, and the Second Line of Defense utilized $183 million.

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108 U.S. Department of Defense, 2009, 14.

109 International Panel on Fissile Materials, "Global Fissile Material Report 2007," http://www.fissilematerials.org/ipfm/site_down/gfmr07.pdf, 8 and Stockholm International Peace Research Institute, 504.

110 U.S. Department of Defense, 2009, 21.

111 U.S. Department of Defense, 2009, 22–23.

112 U.S. Government Accountability Office, GAO-09-257, January 2009, 28.

a. Materials Protection, Control, and Accounting

The MPC&A program, managed by the DOE's National Nuclear Security Agency (NNSA), strives to "secure nuclear weapons and weapons-useable nuclear materials by upgrading security at nuclear storage sites and by consolidating nuclear materials to sites where installation of enhanced security systems have already been completed."[113] The Materials Consolidation and Conversion program and the Global Threat Reduction Initiative (GTRI) are efforts included within the MPC&A funding total.[114]

The MPC&A program provides facility security upgrades in two phases. During the first phase, upgrades consist of measures to delay unauthorized access to nuclear weapons and fissile materials. These measures include high security doors, windows and locks, perimeter fences, and entry control point barriers.[115] The second phase includes comprehensive upgrades in monitoring, alarm, and detection systems, consolidation of protected materials, electronic access measures, and guard force optimization.[116]

Under the MPC&A program, the NNSA identified 105 Russian nuclear storage sites with 223 buildings in need of security upgrades.[117] These sites contain roughly 600 metric tons of fissile material, enough to fabricate approximately 41,000 nuclear warheads.[118] The 105 sites include 63 Ministry of Defense sites (52 warhead and 11 naval reactor fuel), 31 civilian research or reactor sites, and 11 weapon storage sites within the Russian State Nuclear Corporation (Rosatom) complex.[119] NNSA security

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113 Woolf, 27.

114 Ibid.

115 Ibid., 29.

116 Woolf, 29.

117 Ibid.

118 Ibid.

119 Ibid.

assessments indicate that the quantities stored within the Rosatom complex account for more than 80 percent of the total material in need of security upgrades.[120]

The MPC&A program has successfully implemented security measures for over half the 600 tons of fissile material.[121] However, in 2006, the DOE changed the way in which it measured the progress of this program. Reporting now reflects the percentage of facilities with upgrades instead of the percentage of materials protected by the upgrades (Figure 3).[122] This change clearly diminishes the utility of the metrics by providing a deceivingly inflated building completion percentage while a significant quantity of fissile material has not received comprehensive security upgrades. Under the new progress tracking system, DOE reports from September 2007 announced that 90 percent of the rapid and comprehensive upgrades were complete, effecting 194 of the 215 target buildings.[123]

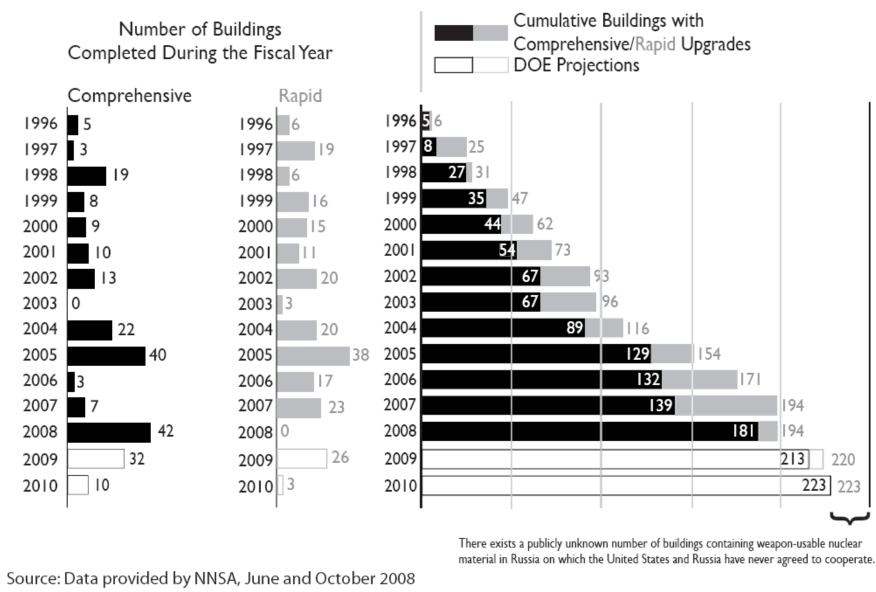

Figure 3. FSU Buildings with DOE Security Upgrades.[124]

[120] Woolf, 29.

[121] Ibid.

[122] Woolf, 29–30.

[123] Ibid., 30.

[124] Bunn, 92.

The DOE Material Consolidation and Conversion project provides assistance by consolidating fissile materials and blending down HEU for use in LEU-fueled reactors or to a purity level unsuitable for weaponization.[125] The plan dictates the removal of nuclear material from 55 buildings and the conversion of 17 tons of HEU.[126] Currently available statistics do not provide the progress of the HEU conversion but do indicate that greater than 40 percent of the buildings have been cleared of nuclear materials.[127]

The DOE's GTRI does not focus on nuclear security threats stemming solely from the FSU. Rather it seeks to pursue global opportunities to secure or remove sources of nuclear material that could be used to fabricate a yield-producing weapon. GTRI has recently accelerated plans to convert 45 HEU-fueled research reactors to LEU but remains largely constrained by diplomatic hurdles and to a lesser extent the funding necessary to incentivize and implement the conversions.[128] Beyond this effort, GTRI seeks to collect an additional 1.4 tons of "other source" HEU by the end of 2013.[129]

b. Second Line of Defense

The DOE Second Line of Defense (SLD) program provides assistance in detecting nuclear and radiological materials at foreign border crossings and ports. The Megaports Initiative represents the largest SLD component. This program seeks to increase the capability to detect and deter smuggling of radioactive materials through

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125 See Ferguson and Potter, 177. The Uranium-235 (U-235) isotope naturally occurs at a concentration of 0.7 percent. Uranium is considered to be highly enriched at 20 percent or greater concentrations of U-235. Low-enriched uranium, typically enriched to 3, 5, or 7 percent, is commonly employed as commercial light-water reactor fuel and cannot be used in a nuclear weapon without further enrichment. While a nuclear bomb could be made from uranium of slightly less than 20 percent enrichment, the size and complexity of the weapon increase dramatically. The actual physics cutoff is 6.9 percent enrichment, below which the critical mass goes to infinity.

126 Woolf, 32.

127 Ibid., 29.

128 Bunn 199.

129 International Panel on Fissile Materials, 2007, 30–31.

major international seaports.[130] This program provides a standoff benefit by screening cargo at foreign points of departure rather than U.S. ports of entry.

In 2003, DOE began deploying radiation detection monitors in conjunction with its Megaports Initiative.[131] Under the Megaports Initiative, the NNSA collaborates with foreign governments to prevent the smuggling of dangerous nuclear materials.[132] Since its inception in 2003, upgrades at only 19 of 75 targeted ports have been completed.[133] A 2005 Government Accountability Office (GAO) report voices concern that the DOE "does not have a comprehensive long term plan to guide the Initiative's efforts."[134] The report goes on to indicate that funding shortfalls, technical challenges with detection equipment, and gaining the cooperation of foreign governments all pose additional operational and technical challenges.[135] Frequent false alarms from naturally radioactive sources such as kitty litter, fertilizer, ceramic tile, and bananas, slow the cargo screening process and in some cases have even led officials to reduce the sensitivity settings or turn off scanning equipment.[136] Under the Megaports program, U.S. personnel do not participate in the cargo screening at foreign ports. Foreign customs officials operate the radiation detection equipment and decide whether to conduct any secondary cargo inspection.[137] Despite these reasonably obvious and well-publicized deficiencies, one might question whether a terrorist would risk moving a scarce and costly nuclear weapon or quantity of fissile material through a monitored port instead of attempting to smuggle materials through remote, less protected routes.

130 U.S. Government Accountability Office, GAO-05-375, 2005, 6.

131 Ibid., 6–8.

132 U.S. Department of Energy, "Nuclear Nonproliferation, Megaports Initiative," National Nuclear Security Administration, http://nnsa.energy.gov/nuclear_nonproliferation/1641.htm.

133 Ibid.

134 U.S. Government Accountability Office, GAO-05-375, 2005, 1.

135 U.S. Government Accountability Office, GAO-05-375, 2005, 1.

136 Ibid., 2, 23.

137 Ibid., 23.

3. DOS Overseas Nuclear Security Programs

With an FY07 budget of $42 million, the DOS Export Control and Related Border Security Assistance (EXBS) program provides radiation detection capabilities at foreign border crossings as well as a wide array of training assistance to the recipient nations. Through these and other measures, the program seeks to fulfill the United Nations Security Council Resolution (UNSCR) 1540 requirement to aid in preventing the proliferation of WMD materials and technology. Similar to other border and port screening assistance efforts, no metrics exist to accurately determine the effectiveness of this program. Inspection officials attempting to move radiological sources through screening portals, also known as "red teams," can provide a general yardstick, however, these types of tests cannot account for materials that simply bypass border and port checkpoints or materials that make it through undetected. The creation and sustenance of international cooperative relationships may be the greatest advantage achieved by these programs. In fact, most recorded border interdictions of nuclear materials have resulted from police, intelligence, and border security interagency cooperation, as opposed to detection by radiological monitoring equipment.[138]

4. DHS Overseas Nuclear Security Programs

Funded at $139 million in FY07, DHS manages the Container Security Initiative (CSI).[139] Through this program, DHS provides foreign ports with multidisciplinary teams of agents to aid in screening maritime cargo containers bound for the U.S. DHS agents utilize x-ray and gamma radiation screening machines to investigate high-risk

[138] U.S. Government Accountability Office, GAO-08-999T, 2008, 11.

[139] U.S. Government Accountability Office, GAO-09-257, January 2009, 27.

shipping containers.[140] As of January 2008, CSI teams were operating at the DHS objective of 58 seaports in 33 countries around the world.[141] These ports account for 86 percent of U.S.-bound maritime cargo.[142]

The CSI program relies heavily on the agent's consistent ability to discern high-risk containers and the screening equipment to identify nuclear materials. The efficiency of this program is difficult to ascertain, since materials that make it through undetected are obviously unknown. However, access to only 86 percent of the more than 10 million containers arriving in the U.S. annually indicates that roughly 1.5 million containers essentially bypass this scrutiny.[143] Of the 8.5 million containers that transited through CSI ports in 2007, 140,000 were selected for screening resulting in an inspection rate of less than two percent.[144] The GAO further notes that limitations in nuclear detection technology coupled with the use of simple shielding methods may allow nuclear materials to pass through the screening apparatus undetected.[145]

While the CSI program attempts to increase the likelihood of interdiction of nuclear and radiological materials during transit through ports, its utility is questionable. Assuming a terrorist or smuggler would attempt to move nuclear materials through a CSI-protected port (as opposed to one of the many that are not); the DHS agents must then determine through investigative means that the container represents a high-risk. As noted previously, with the addition of shielding, a container holding some types of nuclear materials could easily pass through screening undetected. This program likely provides some measure of deterrence, but beyond that, the program itself offers only a minute statistical increase in measurable protection. In fact, it may actually drive

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140 U.S. Department of Homeland Security, "DHS' Domestic Nuclear Detection Office Progress in Integrating Detection Capabilities and Response Protocols OIG-08-19," U.S. Department of Homeland Security, Office of Inspector General, http://www.dhs.gov/xoig/assets/mgmtrpts/OIG_08-19_Dec07.pdf , 11.

141 U.S. Government Accountability Office, *Supply Chain Security, Examinations of High-Risk Cargo at Foreign Seaports Have Increased, but Improved Data Collection and Performance Measures are Needed GAO-08-187,* Washington D.C. Government Accountability Office, January 2008, 12, 20.

142 Ibid., 20.

143 Ibid., 1.

144 Ibid., 23.

145 U.S. Government Accountability Office, GAO-08-187, January 2008, 3.

smugglers toward unprotected borders and ports potentially reducing the likelihood of interdiction. This dilemma highlights the absolute necessity for balance and strategic integration among preventive programs. Strengthened port screening measures might do very little to increase security if not balanced with effective border security measures.

5. Summary of Overseas Nuclear Security Programs

The current failure to integrate U.S. source and border security programs under a single strategic management umbrella complicates the evaluation and implementation of security efforts. In a meeting between Presidents Bush and Putin in December 2005, an agreement was reached to pursue accelerated warhead storage security measures. The United States agreed to provide security assistance at 15 additional sites, eight funded by DoD through the CTR program and seven funded through the DOE nonproliferation budget.[146] This division of responsibilities might expedite the provision of security upgrades but can also present complications. Inter-departmental differences in security standards, equipment, and measurement of effectiveness represent three potentially deficient areas. For example, radiation detection monitors fielded by DOE and DoD detect both gamma and neutron radiation, while more than 20 fielded by DOS can only detect gamma.[147] The DOS detectors have less capability to detect plutonium creating a relative vulnerability in the security architecture.

Despite the demonstrated progress made in weapons dismantlement, a precise inventory and depiction of the security of weapons and fissile material would provide a more accurate measurement of progress. For example, one unprotected weapon poses a much greater security risk than 500 weapons maintained within a sufficiently guarded storage complex. In numerous reports, the GAO consistently criticizes the DNDO and departmental agencies for their poor selection of metrics.[148]

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146 Woolf, 13.

147 U.S. Government Accountability Office, *Combating Nuclear Smuggling GAO-05-840T*, (Washington D.C.: U.S. Government Accountability Office, June 21, 2005) 6.

148 Shea, 7–9.

In spite of the lack of specificity and completeness, the available statistics demonstrate encouraging source security progress (Figures 4 and 5). However, a lack of full transparency and remaining questions regarding the accurate quantities and locations of all nuclear weapons and fissile material prevent gaining a precise assessment of what this progress means in terms of the overall security situation.

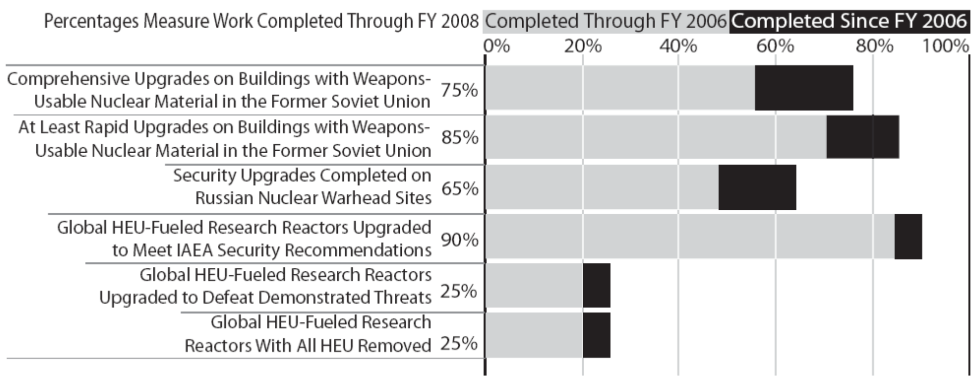
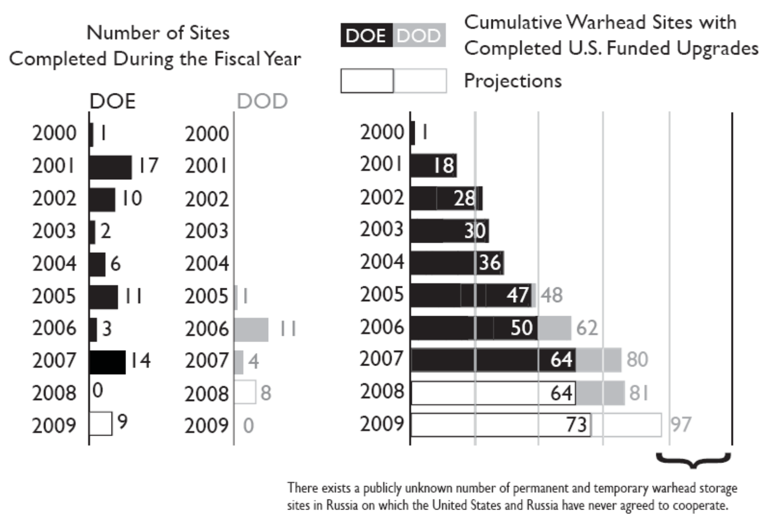


Figure 4. Progress of U.S.-Funded Programs to Secure Nuclear Stockpiles.[149]



Source: Data provided by NNSA, June and October 2008; U.S. Department of Defense, *Cooperative Threat Reduction Annual Report to Congress: Fiscal Year 2009* (Washington, D.C.: DOD, 2008); U.S. Department of Defense, "Nunn-Lugar Scorecard" (Washington D.C.: DOD, updated 20 October 2008).

Figure 5. DoD and DOE Warhead Sites with Security Upgrades.[150]

149 Bunn, 113.

150 Bunn, 95.

While a lack of full transparency prevents a clear analysis of the progress made to secure Russian fissile materials, this research confirms a few key factors. U.S. and Russian efforts under the CTR and MPC&A programs have markedly increased the security of nuclear weapons and fissile materials. Resources invested here have a direct and consequential impact on improving security. One ton of adequately secure HEU or plutonium effectively results in one ton being less accessible to smugglers or terrorists. However, considerable room for improvement remains. While the site security measures implemented in Russia by DOE and DoD are considered effective, they are only implemented at sites agreed upon between Russia and the U.S. The agreed upon sites do not house Russia's entire nuclear arsenal or stockpile of fissile material. Russian reluctance to open all facilities continues to slow or in some cases prevent progress.

Primarily diplomatic delays and not funding shortages have resulted in the plodding progress achieved over the last 18 years. Of the $1.1 billion spent on overseas programs in FY07, roughly $540 million directly funded securing nuclear weapons or fissile materials in transit or storage. The remaining $580 million funded overseas border and port security enhancements, training and administrative costs. While it might initially appear that too small a percentage of the overall budget actually affects the areas in greatest need of resources, the application of more money cannot bypass the diplomatic hurdles that prescribe the rate of implementation.

C. U.S. BORDER AND INTERNAL SECURITY PROGRAMS

1. DOE Programs within the United States

Domestically, DOE focuses its resources and expertise on securing U.S. nuclear assets. In FY07, DOE spent $846 million to provide security for U.S. nuclear weapons, components, special nuclear materials, and DOE operating locations.[151] Similar to DOEs efforts in Russia, these programs endeavor to prevent even a single instance of theft, loss, diversion, unauthorized access, or a successful terrorist attack. Despite a sound track record depicting no instances of a weapon or significant quantity of fissile material ever

151 U.S. Government Accountability Office, GAO-09-257, January 2009, 29.

being compromised, some suggest that vulnerabilities in the U.S. nuclear complex should receive immediate attention.[152] The International Panel on Fissile Materials (IPFM), supported by Princeton University, states that U.S. nuclear material consolidation efforts are proceeding too slowly and have not taken advantage of every opportunity to close sites and reduce the number of facilities.[153] The report further notes that DOE sites, such as Los Alamos National Laboratory, Y-12, Oak Ridge National Laboratory, and Hanford, have all received waivers exempting them from the more rigorous 2005 Design Basis Threat (DBT) security requirements. These observations merit consideration. However, the security afforded to U.S. nuclear materials, coupled with the immediate and unhindered ability to respond to a domestic incident of theft or diversion creates a formidable security barrier.

2. DHS Programs within the United States

The Department of Homeland Security plays the central role in preventing terrorists or other unlawful actors from moving nuclear weapons or fissile materials into and within the U.S. DHS spent $274 million on domestic border and internal nuclear security measures in FY07. The vast majority, $209 million, funded the Advanced Spectroscopic Portals and Radiological Portal Monitor programs.[154]

U.S. Customs and Border Protection use both handheld and portal radiation detection systems to prevent nuclear materials from entering the U.S. As of December 2007, DHS had achieved the Congressional mandate to scan all cargo containers coming through the 22 largest U.S. seaports. This represents 98 percent of the containers shipped to the U.S.[155] Furthermore, 100 percent of the truck cargo arriving from Mexico and 91

152 International Panel on Fissile Materials, 2007, 43.

153 Ibid.

154 U.S. Government Accountability Office, GAO-09-257, January 2009, 29.

155 Bunn 75.

percent from Canada receive scanning for nuclear materials.[156] An aggregate of 96 percent of all land and sea containerized cargo entering the U.S. now receives scanning for nuclear materials.[157]

In total, DHS has installed over 470 radiation monitors around the U.S. at international mail and package handling facilities, land border crossings, and seaports.[158] Some suggest that while many of the DHS screening efforts present easily circumvented defenses, they at least provide increased layers of protection against terrorists and additional opportunities to interdict an illicit movement.[159] Port and border security poses a significantly different challenge than source security and is often equated to trying to find a needle in a haystack: in this case, a needle likely employing extreme measures to avoid detection. Robert Nesbit, co-chair of the Defense Science Board's Task Force on Strategies to Reduce the Risk of Terrorist Attacks with Nuclear, Chemical or Biological Weapons, explained in a 2008 testimony to Congress that if a theft or transfer to terrorists occurs, "we are in big trouble…it would be very difficult to detect in transit, stop, and secure the device prior to detonation."[160]

Through an independent evaluation, the DNDO identified numerous gaps in domestic security, including vulnerabilities posed by land border crossings into the U.S. among formal points of entry, small maritime vessels, and international general aviation aircraft (Table 3).[161]

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156 Bunn, 75–76.

157 Ibid.

158 U.S. Government Accountability Office, GAO-05-840T, June 21, 2005, 2.

159 Jonathan Medalia, *Nuclear Terrorism: A Brief Review of Threats and Responses*-RL32595, Congressional Research Service, February 10, 2005, http://www.fas.org/sgp/crs/nuke/RL32595.pdf, and Bunn, 70, 75.

160 Bunn, 70.

161 U.S. Government Accountability Office, GAO-08-999T, 2008, 6.

Length of U.S. Borders (miles)			
Alaska coast	6,640	Atlantic coast	2,069
Hawaii coast	750	Great Lakes	970
Pacific coast excluding Alaska and Hawaii	1,293	Alaska-Canada border	1,538
Border with Mexico	1,933	Border with Canada excluding Alaska and Great Lakes	3,017
Gulf of Mexico coast	1,631	**Total**	**19,841**

Table 3. Length of U.S. Borders[162]

With nearly 20,000 miles of border, DHS may never be able to effectively secure all of it to the extent necessary to prevent the entry of a minimum quantity of fissile material necessary to produce a single nuclear device. In attempting to do so, DHS may currently be over reliant on immature technological solutions and other border security resources. In 2007, the GAO criticized the procurement of the Advanced Spectroscopic Portal (ASP) monitor and the Cargo Advanced Automated Radiography System (CAARS), stating that their system reliability was based on anticipated performance levels not actual test data and that the proposed testing regime would not effectively assess the systems' capabilities.[163] On 8 May 2009, the Obama administration announced it would discontinue future funding for the ASP monitors and the CAARS without any indication of what equipment or measures would be employed in their absence.[164]

3. Summary of Domestic Nuclear Security Programs

A great deal of resources are expended on programs to adequately secure U.S. nuclear weapons and fissile material. As a result, U.S. nuclear materials are extremely

162 Medalia, 6.

163 U.S. Government Accountability Office, *Combating Nuclear Smuggling GAO-07-1247T* (Washington D.C.: U.S. Government Accountability Office, September 18, 2007) 3.

164 Global Security Newswire "Homeland Security Backs Off Funding for Nuclear-Detection Technology" (National Journal Group, May 8, 2009). http://www.globalsecuritynewswire.org/gsn/nw_20090508_6590.php.

well protected and progress is continually being made toward further improvement. Most can agree that while the U.S. nuclear complex could benefit from some specific security enhancements, the materials and weapons stored in the U.S. are comparatively much safer and under much better control than those anywhere else in the world.

The resources applied to border and port security present more difficult concerns. A layered security approach is appealing in theory, however, a lack of technology to effectively screen cargo for nuclear material coupled with expansive border regions lacking any protection diminish the utility of this strategy. While current detection capabilities are clearly wanting, historically, the U.S. has not responded to challenging situations by simply conceding defeat. The technological challenges in detecting nuclear materials should be viewed as the foremost opportunity to improve the security environment by applying the vast scientific resources of the U.S. Border security and cargo screening capabilities and the underpinning research and development represent areas in dire need of additional resources and of greater political and strategic emphasis. While these focal areas do not currently provide the same tangible security benefits that source security measures offer, they do reflect areas where the greatest degree of improvement could be achieved. Furthermore, these efforts do not rely on the painfully slow navigation of diplomatic channels. Advancements in these areas could be implemented as soon as they were developed. Finally, one might argue that domestic port and border screening may occur too late to significantly reduce the consequences of an attack. While this perspective holds a degree of merit, it assumes that the technology could not be fielded at offshore cargo screening sites or at overseas sites manned by U.S. security personnel (such as the CSI ports). Other potential cargo screening and border security solutions must be explored and resourced if the U.S. sincerely desires to mitigate the threat of a domestic nuclear terrorist attack.

D. CONCLUSIONS

Collectively, source, border, and port security measures do not currently approach forming an impenetrable protective framework. The efficacy of the Global Nuclear Detection Architecture and its constituent programs must weigh the objective against the

reality of the situation. The strategic intent of these programs is not to simply reduce the flow. To be effective they must prevent even one weapon's worth of fissile material from being transported and employed by terrorists. The challenges and complexity of this objective must be fully understood so that logical and effective threat response measures can be funded and implemented to quickly reduce the risk to the greatest extent possible.

Numerous overseas sources remain insufficiently secure and, in many cases, poor transparency prevents establishing a firm accounting of materials and weapons where additional security is needed. In FY 2009, while the U.S. appropriated $1.083 billion for programs to improve overseas controls on nuclear weapons, materials, and expertise, less than half, only $457.9 million actually went toward securing weapons and fissile materials at their source.[165] This represents an 18 percent decrease from the FY08 budget and only 16 percent of the $2.8 billion appropriated for all nuclear security programs contained within the Global Nuclear Detection Architecture.[166] Although significant progress has been made, it has taken nearly 18 years with another five remaining before several U.S. funded efforts are scheduled to reach completion.

In reality, diplomatic hurdles and not fiscal resources pose the greatest challenge to implementing effective overseas source security programs. As a result, states of concern, such as Russia, North Korea, Pakistan, India, and Iran, that continue to impede full transparency and access will prevent the application of suitable and verifiable security measures. While the immediate appropriation of additional resources would not help accelerate current efforts, a pre-approved funding line should be established to aid in responding quickly when unanticipated opportunities arise to offer source security assistance.

HEU and plutonium each provide detection challenges and with little effort can be made virtually undetectable by many of the border and port screening systems currently fielded.[167] This apparent vulnerability generates its own complications for terrorists

165 Bunn, 115.

166 Bunn, 115, and U.S. Government Accountability Office, GAO-08-999T, 2008, i.

167 U.S. Government Accountability Office, GAO-08-999T, 2008, 3, 10.

however. While a sophisticated nuclear device might require several hundred pounds of lead shielding to bring the radiation below detectable levels, a crudely constructed bomb might require several tons of shielding.[168] In either case, the movement and concealment of a nuclear weapon or materials would be complicated by the size and weight of the shielding. Unfortunately, an unintended consequence of more effective border and port security efforts may simply direct terrorists to other less protected avenues of approach, including U.S. borders that annually allow 500,000 illegal immigrants across and stop only 10-15 percent of illegally trafficked narcotics.[169] Clearly, the importance of cargo and border security is critical and both areas represent opportunities for vast improvement. Furthermore, a strengthening of border and cargo security to prevent nuclear smuggling would also have ancillary benefits in stemming the flow of illegal immigrants, narcotics, and other types of illicit trafficking. Finally, while foreign source, cargo, and border security programs can only be implemented at a rate dictated by diplomatic progress, domestic border and cargo securities are not similarly constrained.

Most existing literature categorizes nuclear threat response programs along departmental or overseas versus domestic lines. Through this panoramic examination of the primary programs involved in the global nuclear detection architecture, a separate and distinct division becomes apparent that garners little attention in GAO, departmental, or scholarly analysis. This distinction lies in the underemphasized but consequential differences in measureable effectiveness and unilateral implementation ability among proactive and reactive threat response programs. In defining this differentiation, proactive measures represent those that seek to maintain control and accountability of nuclear weapons and fissile material whereas reactive measures consist of those effort undertaken to track and recover materials over which sufficient control has been lost. While frequently studied together as comparable components of the Global Nuclear

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168 Allison, 160.

169 N.C. Aizenman, "Number of Illegal Immigrants to U.S. Is Down, Report Finds," *Washington Post* (October 3, 2008) http://www.washingtonpost.com/wp-dyn/content/story/2008/10/02/ST2008100203040.html. and, Tyche Hendricks, "On the Border, Smuggling a Whole Lot of Drugs a Little at a Time," *San Francisco Chronicle* (January 28, 2007) http://www.sfgate.com/cgi-bin/article.cgi?f=/c/a/2007/01/28/MNGCJNQHO01.DTL.

Detection Architecture, segregating proactive and reactive programs in comparative analysis provides an alternative perspective that facilitates identifying specific elements of utility.

Focus	**Program**	**Possible Speed of Implementation**	**R&D Required**	**FY 07 Appropriation (millions)**	**Quantifiable Results**	**Direct Impact on Security**	**Ease of Circumvention**	**Diplomatic Constraints**
Proactive-Overseas	CTR-Nuclear Weapons Safety and Security (DOD)	1-3 Years	No	$92.8	Yes	Yes	Difficult	High
	CTR-Nuclear Weapons Transportation Security Program (DOD)	1 Year	No	$32.7	Yes	Yes	Difficult	High
	MPC&A (DOE)	1-3 Years	No	$414	Yes	Yes	Difficult	High
Proactive-Domestic	Nuclear Complex Security (DOE)	1-3 Years	No	$846	Yes	Yes	Difficult	Low
Reactive	CTR-Proliferation Prevention Initiative (DOD)	Continuous	Yes	$32.4	No	No	Easy	High
	Second Line of Defense (DOE)	5-10 Years	Yes	$183	No	No	Easy	High
	EXBS (DOS)	Continuous	Yes	$42	No	No	Easy	High
	CSI (DHS)	5-10 Years	Yes	$139	No	No	Easy	Moderate
	ASP/CARS monitors (DHS)	Immediate with ongoing R&D	Yes	$209	Some	Some	Moderate	Low
Cross-cutting Programs	Research and Development and Training Efforts	Continuous	Yes	577.12	No	No	N/A	Low
Overhead	Administrative Costs	Continuous	No	$231	N/A	N/A	N/A	N/A

Table 4. Proactive Versus Reactive Program Effectiveness Comparison

Overseas proactive measures, which secure materials at their sources and in transit, such as the CTR, MPC&A, and GTRI, bear results that can be quickly obtained when funding and political hurdles are cleared. Their results are measurable, relatively predictable, and directly reduce the threat. Furthermore, the measures undertaken to secure nuclear materials at storage sites and in transit do not burden the budget or delay the timeline with technological research and development requirements. The technology to secure materials is mature, comparatively inexpensive, and can be rapidly deployed. The primary way for terrorists to circumvent well-implemented source security measures would be to move to another source. This effect concentrates their efforts making them more detectable and easier to interdict.

Despite some considerable advantages, overseas proactive source security measures bear certain drawbacks that must be carefully considered. First, they are constrained by the willingness of the host nation. At any point before, during or after the implementation of security upgrades, a diplomatic failure could end or delay progress. Second, security measures can only be directed toward identified sources. Continued proliferation among states uncoopertive with IAEA inspection protocols will increasingly complicate efforts to secure all fissile material. Finally, provided security systems are owned, operated and maintained by the recipient state's security personnel. Cultural, religious, economic or a host of other issues could lead to the circumvention of security systems and are completely outside the control of the U.S. Ultimately, overseas proactive source security measures may be deceptively promising and the inability to comprehensively apply these measures significantly reduce their credibility as the cornerstone of a preventive strategy.

Conversely, reactive programs, seek to detect and interdict movement of nuclear materials at border crossings, through ports, and other shipping modes. As demonstrated by the Obama administration's recent cancellation of spectroscopic portal monitors, this technology is not mature or sufficiently effective. Research and development efforts risk failure, are expensive, and can take years to complete, each reducing the ability to apply rapid security improvements. The beneficial effects of screening are difficult to quantify and porous borders make circumvention an obvious and fairly easy alternative. In fact,

land border crossing and port screening might ultimately disperse terrorist and smuggling activity, encouraging their movement toward unprotected border crossings where interdiction becomes exceedingly unlikely. These shortfalls, however, should inspire increased attention and the application of greater resources. Many reactive programs are completely within the purview of U.S. unilateral implementation and as a collective category represent those programs with the greatest capacity to increase security.

By distinguishing between proactive and reactive programs, it becomes apparent that the proactive source security programs receive a significant portion of the annual budget (Figure 6). However, analysis of some of the underlying implementation factors reveals that overseas source security measures should not be over relied upon and that the strategic layer in greatest need of additional resources and emphasis is border and cargo security and the associated R&D necessary to expand interdiction capabilities.

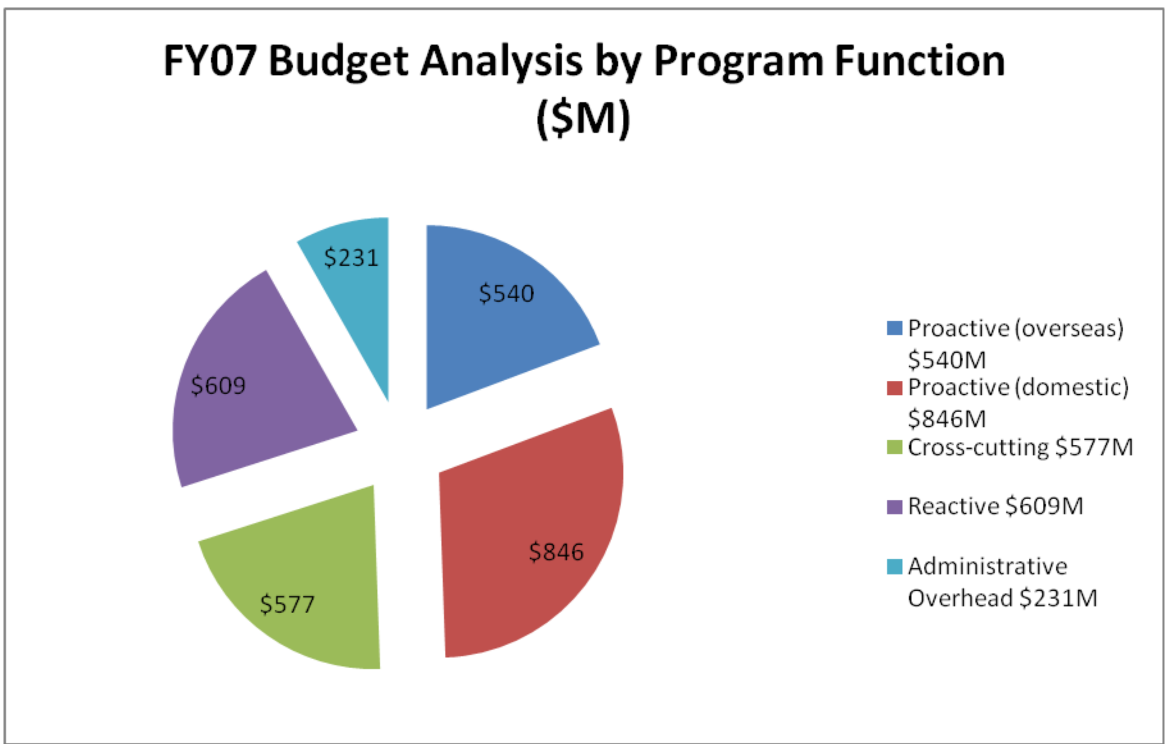

Figure 6. Proactive Versus Reactive Budget Comparison

Less than 25 percent of the $2.8 billion annual global nuclear detection architecture budget is applied toward proactive measures to secure overseas sources of nuclear materials. However, overseas source security programs do receive adequate resources to proceed at the rate dictated by current diplomatic progress. Rather than trying to apply more resources, it may be more beneficial to increase the sense of urgency and importance on the political and diplomatic front in an effort to open new CTR venues. When international negotiations present an opportunity to secure, consolidate, destroy, or remove nuclear material, every effort should be undertaken to accomplish that objective as quickly as possible. It must, however, be remembered that overseas proactive source security measures may never eliminate the hazard in its entirety, and gaps in the remaining security architecture will continue to pose ongoing concerns unless a greater degree of reliability can be achieved among reactive security measures.

This chapter explored the balance of resources and quantifiable effects of the primary preventive programs within the Global Nuclear Detection Architecture. The research showed that the quantifiable utility of proactive source security programs far exceed that of reactive border and port detection efforts. This may represent one reason that politicians appear to favor source security programs so heavily. Tangible, short-term benefits are always much easier to convey to constituencies. Despite this difference, there are clear opportunities and compelling arguments for pursuing reactive measures with much greater enthusiasm.

While the fluid nature of the threat should discourage a fixed proportional resource distribution, this research has shed light on specific instances where a calibration of resource distribution may be in order. The area of greatest weakness and in need of immediate attention is that of (reactive domestic and overseas) border and cargo security as well as the underlying research and development necessary to increase security in these areas. Second, proactive overseas security programs have and continue to receive the funding necessary to keep pace with diplomatic progress. However, the U.S. should maintain the flexibility to quickly apply resources if new security opportunities arise.

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III. RISK ANALYSIS OF A DOMESTIC NUCLEAR TERRORIST ATTACK: PRIORITIZING MITIGATION OPPORTUNITIES

The estimated risk of a terrorist nuclear attack cannot be derived from the efficiency or inefficiency of preventive programs or their fiscal appropriations. The terrorists have a vote and must possess the desire and capability to carry out such an attack for a risk to exist. To maximize efficiency, preventive programs must precisely target specific elements that make up the risk they seek to mitigate.

Risk represents the potential occurrence of an unwanted outcome resulting from an event as determined by its likelihood and the associated consequences.[170] Subsequently, risk analysis can provide important insights to aid in prioritizing mitigation efforts and resources. While various risk assessment methodologies exist, the Department of Homeland Security (DHS), under the National Infrastructure Protection Plan (NIPP) framework, defines risk as a function of *threats, vulnerabilities, and consequences*.[171] In keeping with the NIPP methodology, a threat estimate is obtained through an assessment of terrorists' intentions and capabilities to execute an attack. Next, attributes that make an asset more susceptible to a selected hazard represent vulnerabilities. Whether qualitative or quantitative, a depiction of overall vulnerability typically captures the likelihood of an attack being successful once it has been initiated. Finally, the consequences of an incident reflect the level, duration, and nature of the resultant loss. Consequences, under the NIPP framework, include health and safety, economic, psychological, and governance impacts.[172]

The formulaic representation of risk, R = f(T,V,C), demonstrates an important mathematical and methodological aspect of the relationship; some measure of each factor must be present to produce risk. For instance, a scenario does not effectively generate

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170 U.S. Department of Homeland Security, "National Infrastructure Protection Plan," 2009, http://www.dhs.gov/xlibrary/assets/NIPP_Plan.pdf, 27.

171 Todd Masse, Siobhan O'Neil, and John Rollins, *The Department of Homeland Security's Risk Assessment Methodology: Evolution, Issues, and Options for Congress*-RL33858, Congressional Research Service, February 2, 2007 http://www.fas.org/sgp/crs/homesec/RL33858.pdf, 12–15 and U.S. Department of Homeland Security, "National Infrastructure Protection Plan," 32.

172 U.S. Department of Homeland Security, "National Infrastructure Protection Plan," 32.

risk if a threat and vulnerability exist without a consequence. Assuming a measure of all three factors is present, if any single factor can be reduced, the resultant risk is lowered. In this case, the risk of a domestic nuclear terrorist attack may be lowered if one or more risk factors can be reduced by identifying and applying focused mitigation efforts.

This chapter explores the various elements of risk as they apply to the scenario of a domestic nuclear terrorist attack. Through an analysis of the components of risk, (threat intentions and capabilities, vulnerabilities, and consequences,) specific attributes and relationships emerge that provide insight into where preventive programs might be focused to achieve the greatest degree of efficiency in reducing the risk of a domestic nuclear terrorist attack. This chapter concludes that the security of domestic nuclear weapons and materials must represent the highest priority followed by increased U.S. border and transitory security and finally the ongoing implementation of overseas source security measures. Based upon current levels of security, this chapter finds that port and border security programs, especially those protecting the U.S. border, must receive a greater degree of investment and emphasis in order to balance their effects with those of the other layers of security.

A. THREAT ANALYSIS

When considering any terrorist attack scenario, DHS defines threat as a combination of the intent and capability of the potential assailant.[173] Both must be present to form a credible threat. However, accurate and demonstrable depictions of these factors can be difficult to ascertain. Both terrorists and belligerent state actors frequently undertake denial and deception to gain political leverage or strategic advantage.[174] The burden of lifting the veil on the intent and capability of these adversaries lies largely on the shoulders of the Intelligence Community (IC). To be effective, the IC must determine which terrorist groups show interest in pursuing a nuclear capability, the progress made in that pursuit, and their ability to carry out an

[173] U.S. Department of Homeland Security, "National Infrastructure Protection Plan," 33.

[174] Jennifer E. Sims, and Burton Gerber, *Transforming U.S. Intelligence* (Washington D.C.: Georgetown University Press, 2005), 136.

attack by various means.[175] This research considers the threat elements of intent and capability independently because an increased understanding of either factor can assist security agencies in directing efforts toward more efficient and precisely targeted preventive measures.

1. Threat Intentions

According to the Center for Nonproliferation Studies' WMD Terrorism Database, the number of terrorist attacks including some form of chemical, biological, radiological or nuclear (CBRN) component has increased over the past decade.[176] Terrorist groups most likely to pursue an act of nuclear terrorism can be organized into four categories: apocalyptic groups, politico-religious groups, traditional nationalist/separatist groups, and single-issue groups.[177] Of these four groups, the apocalyptic and politico-religious groups display the greatest degree of motivation to cause mass casualties, making them the most likely candidates to pursue an act of nuclear terrorism.[178] The other groups would likely use the threat of a nuclear attack to obtain political objectives or gain recognition but would not risk the international backlash that would follow an actual attack.[179]

An act of nuclear terrorism by any type of group would require careful planning and the conscious decision to pursue such a complex, lethal, and socially offensive attack. Terrorists would have to consider how well this type of attack would promote their intended goals, as well as the costs, risks, and technical complexities involved. The growing lethality of attacks and expanding use of CBRN suggests terrorists' desire to seek increasingly dramatic spectacles of violence.[180] Without any doubt, an act of nuclear terrorism would achieve a dramatic psychological reaction, a common goal among all types of terrorists.

[175] Mark M. Lowenthal, *Intelligence* (Washington D.C.: CQ Press, 2009), 260.

[176] Ferguson and Potter, 17.

[177] Ibid., 18.

[178] Ibid., 18, 38.

[179] Ibid., 23.

[180] Ibid., 27.

Due to the motivational, organizational, financial, and technical requirements necessary to detonate any type of nuclear device, it appears relatively easy to narrow the list of groups that might reasonably be willing to pursuing this goal. Although there may be new, yet unidentified groups out there, most known terrorist groups have elected to abstain. As the most prominent exceptions, Aum Shinrikyo and al Qaeda have each attempted to obtain nuclear materials and weapons.[181] Aum Shinrikyo sought a nuclear weapon in an attempt to start a nuclear war and initiate Armageddon, although technical difficulties prevented any significant headway.[182] Likewise, Osama bin Laden clearly expressed al Qaeda's need and right to pursue nuclear weapons stating:

> Acquiring weapons for the defense of Muslims is a religious duty. If I have indeed acquired these weapons, then I thank God for enabling me to do so. And if I seek to acquire these weapons, I am carrying out a duty. It would be a sin for Muslims not to try to possess the weapons that would prevent the infidels from inflicting harm on the Muslims.[183]

While some terrorist groups might possess strategic reasons for pursuing nuclear terrorism, only a small number have actually considered this type of attack. An even smaller population has actually explored the building blocks necessary to construct a plan of action and only a few have taken any operational steps to achieve this end.[184] Numerous factors have swayed terrorists away from pursuing an act of nuclear terrorism. These factors can be divided into four groups: implementation challenges, philosophical or moral issues, response fears, and insufficient capability.[185] These four groupings represent the key reasons interested terrorists have not pursued nuclear means and areas where preventive efforts can be applied or existing ones strengthened. Further analysis of

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181 For examples see Jason Pate and Gary Ackerman, "Assessing the Threat of WMD Terrorism," James Martin Center for Nonproliferation Studies, CNS Reports (2001), http://cns.miis.edu/pubs/reports/wmdt.htm, Sims and Gerber, 201, Lowenthal, 260, and 9-11 Commission, *The 9/11 Commission Report: Final Report of the National Commission on Terrorist Attacks Upon the United States -- Authorized Edition* (New York: W.W. Norton & Company, 2004), 60–61.

182 Bob Graham et al., 16–17.

183 Ferguson and Potter, 31.

184 Ibid., 32.

185 Ibid.

these groups reveals that deterrence by punishment, deterrence by denial, and a standard of normative behavior provide a large measure of the dissuading influence.

As depicted by Thomas Schelling, deterrence by punishment represents a case in which one side's threat of action makes the other yield or comply with stated desires.[186] The side being deterred exhibits the desired behavior out of the expectation and fear of the violence that will follow disobedience. Ultimately, deterrence achieves its effects through psychological rather than physical means.[187] Some terrorists' apparent eagerness to die for their cause suggests irrationality and that targeting their membership or affiliations with lethal retribution could be ineffective. However, this assessment may prove inaccurate when considering the effects of the surprisingly violent and focused U.S. military response following 9/11. Despite obviously porous U.S. port and border security and the vast number of largely unprotected domestic targets, one might conclude that al Qaeda, at least for now, has received the message that it is unwise to attack the U.S. at home. The absence of any attack or even a substantial threat of a domestic terrorist attack in the eight years since 9/11 remains a debatable testament to the deterrent effect of the Global War on Terror and the campaigns in Afghanistan and Iraq. Given the response to 9/11, an imaginative but conventional attack, terrorists must see that a nuclear attack would hold disastrous consequences for the offending party.[188] The deterrent effect of the threat of retaliation is amplified as more states express their commitment to support severe retaliatory responses. As the magnitude and likelihood of punishment increases, terrorists considering the pursuit of a nuclear attack may be persuaded to refrain completely or at least employ other means.[189] Conversely, if a nuclear attack were to occur and go unpunished, the credibility and effectiveness of the deterrent threat would be significantly diminished.

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186 Thomas C. Schelling, *Arms and Influence,* (New Haven: Yale University Press, 2008), 3–5.

187 Paul Gordon Lauren, Gordon A. Craig, and Alexander L. George, *Force and Statecraft, Diplomatic Challenges of Out Time* (Oxford: Oxford University Press, 2007), 177.

188 Ferguson and Potter, 29.

189 Ibid., 32.

Deterrence by denial represents a defensive strategy in which applied measures effectively raise the cost of a given action.[190] While more extreme terrorists may be unaffected by threats of punishment, deterrence by denial may introduce difficulties that dissuade a nuclear attack in favor of a less costly alternative or one with a greater likelihood of success. Measures taken to prevent access to nuclear materials or to restrict avenues or modes of material transportation may deter terrorists by increasing the difficulty, costs, and the risks associated with this specific type of attack. This method of deterrence will not prevent all terrorist acts of violence. It may however persuade terrorists to pursue other potentially less lethal, non-nuclear methods if thoughtfully applied toward that end. While terrorist acts of violence are generally undesirable, a conventional attack in lieu of a nuclear attack represents a beneficial, lesser-of-two-evils alternative.

Finally, normative behavior plays a role in discouraging acts of nuclear terrorism. The lack of a precedent provides a significant deterrent, indicating that other terrorist groups have found this option too difficult, too likely to incur massive retaliation, or simply unsuitable for furthering their objectives.[191] The reinforcement and continuation of this behavior is of paramount importance. After a terrorist nuclear attack, the taboo would be broken and others may be more likely to follow suit.

Whereas opportunities to influence terrorists' behaviors exist, simply recognizing the intent may pose a more difficult challenge. Despite U.S. intelligence organizations' success in identifying a few terrorist groups' intentions and attempts to acquire a nuclear capability, some states have been able to cross the nuclear threshold with little or no accurate warning. India's test of nuclear bombs in both 1974 and 1998 came as both a surprise and an embarrassment to the IC.[192] Conversely, the October 2002 National Intelligence Estimate (NIE) that provided the rationale for going to war with Iraq, proved to be a gross overestimation.

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190 Lauren, Craig, and George, 178.

191 Ferguson and Potter, 29–30.

192 Jeffrey T. Richelson, *Spying on the Bomb* (New York: W.W. Norton & Company, Inc., 2007), 232, 434, and Sims and Gerber, 72.

Currently, attempting to define Iran's intent poses a significant challenge to the IC. While Iran maintains that all of its nuclear activities are for peaceful purposes, many are concerned that the nuclear materials and technology could enable the production of weapons.[193] Iran's ties to the Iraqi insurgency and Hezbollah create additional concerns regarding the possibility that it might provide fissile materials or a nuclear bomb to a terrorist organization.[194] North Korea's successful test of a nuclear bomb and subsequent increase in international prominence may provide an additional incentive for Iran and others to pursue a weapons program.[195] However, without any confirmation, Iran's intentions, whether peaceful or hostile, will remain unknown and difficult to oppose.

In assessing the intent of others, examples of both successes and failures abound. Furthermore, intent is not an either-or prospect; it represents a continuum from the first thought up to the point of an attack. In some cases less substantive indicators of intent, which can be confounded through deception and denial, must suffice for making policy decisions. A broad coalition applying deterrent threats, deterrence by denial measures employed to increase the costs and difficulty of an attack, and the public reinforcement of normative behavior each hold promise as areas where additional emphasis could significantly reduce the nuclear inclinations of an already extremely small population of terrorists interested in pursuing this type of attack.

2. Threat Capability

The ability to acquire or build a nuclear weapon and deliver it to a target would require a large organization with significant financial and technological resources and represents an enormously complex undertaking.[196] To analyze terrorists' capabilities this section explores potential sources of nuclear weapons or materials, methods of obtaining a weapon or materials, and the necessary requirements to construct, transport and operate

[193] Joseph Cirincione, Jon B. Wolfsthal, and Miriam Rajkumar, *Deadly Arsenals, Nuclear, Biological, and Chemical Threats* (Washington D.C.: Carnegie Endowment for International Peace, 2005) 299.

[194] Dalia Dassa Kaye and Frederic M. Wehrey, "A Nuclear Iran: The Reactions of Neighbors," *Survival* 49:2, 111–128 (2007), http://pdfserve.informaworld.com/802152_731325979_779310491.pdf, 118.

[195] Lowenthal, 261.

[196] Ferguson and Potter, 34.

a nuclear weapon. This analysis highlights opportunities where security emphasis could significantly constrain terrorists' ability to conduct a nuclear attack and provide additional preventive pressure.

a. Potential Sources: A Global Nuclear Inventory

A global survey of the locations and quantities of nuclear weapons, HEU, and plutonium can provide an indication of where terrorists might seek a source of supply. There are currently nine states known or reasonably presumed to possess nuclear weapons: the United States, Russia, China, the United Kingdom, France, Pakistan, India, Israel, and North Korea.[197] Of the states with nuclear weapons, the U.S. and Russian arsenals represent over 95 percent of the global inventory.[198] Despite significant reductions made by both the U.S. and Russia since the end of the Cold War, more than 20,000 nuclear weapons remain in their combined stockpiles (Table 5).[199]

197 Leonard A. Cole, "WMD and Lessons from the Anthrax Attacks," in *Weapons of Mass Destruction and Terrorism*, ed. Russell D. Howard and James J. F. Forest (McGraw-Hill, 2008), 89–90 and International Panel on Fissile Materials, "Global Fissile Material Report 2007," http://www.fissilematerials.org/ipfm/site_down/gfmr07.pdf, 8.

198 Bunn, 83.

199 International Panel on Fissile Materials, "Global Fissile Material Report 2008," http://www.fissilematerials.org/ipfm/site_down/gfmr08.pdf, 8.

Country	Nuclear Warheads
United States	about 10,000 5000 deployed + 5000 awaiting dismantlement
Russia	about 10,000 Large uncertainty as to the number of warheads awaiting dismantlement
France	fewer than 300
United Kingdom	185
China	about 240
Israel	100 – 200
Pakistan	about 60
India	60 – 70
North Korea	fewer than 5

Table 5. Estimated Total Nuclear Weapons Stockpiles, 2008.[200]

In addition to weapons, global stockpiles of HEU and plutonium represent a more widespread and frequently less secure potential source of nuclear bomb building material. In mid-2008, the global supply of HEU was estimated at 1,670 +/- 300 metric tons.[201] The United States and Russia alone possess over 95 percent of the global HEU supply.[202] Despite U.S. and Russian programs to blend down excess HEU to LEU for use as reactor fuel, these two countries have retained a combined total of between 1,200 and 1,800 tons of HEU, a quantity sufficient for producing between 25,000 and 50,000 nuclear warheads (Figure 7).[203]

200 International Panel on Fissile Materials, 2008, 8.

201 Ibid., 7.

202 Bunn, 84.

203 International Panel on Fissile Materials, 2008, 11.

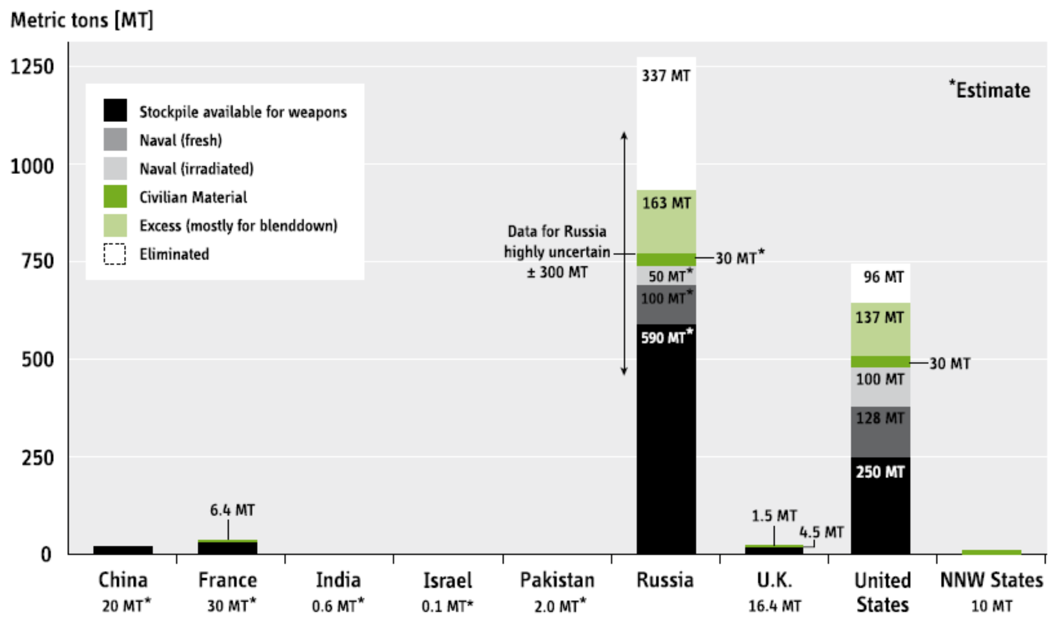

Figure 7. National Stocks of Highly Enriched Uranium as of mid-2008.[204]

In addition to military applications, HEU has also been used at locations around the world as fuel for research reactors. While the U.S. has led a worldwide effort to secure civilian HEU and convert reactors to use LEU fuel, 28 countries still maintain enough HEU reactor fuel to build at least one nuclear bomb and approximately 140 HEU-fueled reactors remain in operation.[205]

Although the reduction of global HEU inventories is promising, world supplies of plutonium, obtained through the separation of spent reactor fuel, represents an area of deepening concern. Of the global supply of approximately 500 tons of plutonium, the total is roughly split between military and civilian stockpiles.[206] Despite this distinction, nearly all of the plutonium is considered of sufficient quality for weapons use.[207] The U.S. and Russia possess around 90 percent of the 250 tons used for military purposes, while ten additional nations retain the remaining military and civilian inventories (Figure 8).

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204 International Panel on Fissile Materials, 2008, 11.

205 International Panel on Fissile Materials, 2007, 3, 8.

206 Bunn, 84, and International Panel on Fissile Materials, 2008, 15.

207 International Panel on Fissile Materials, 2007, 13.

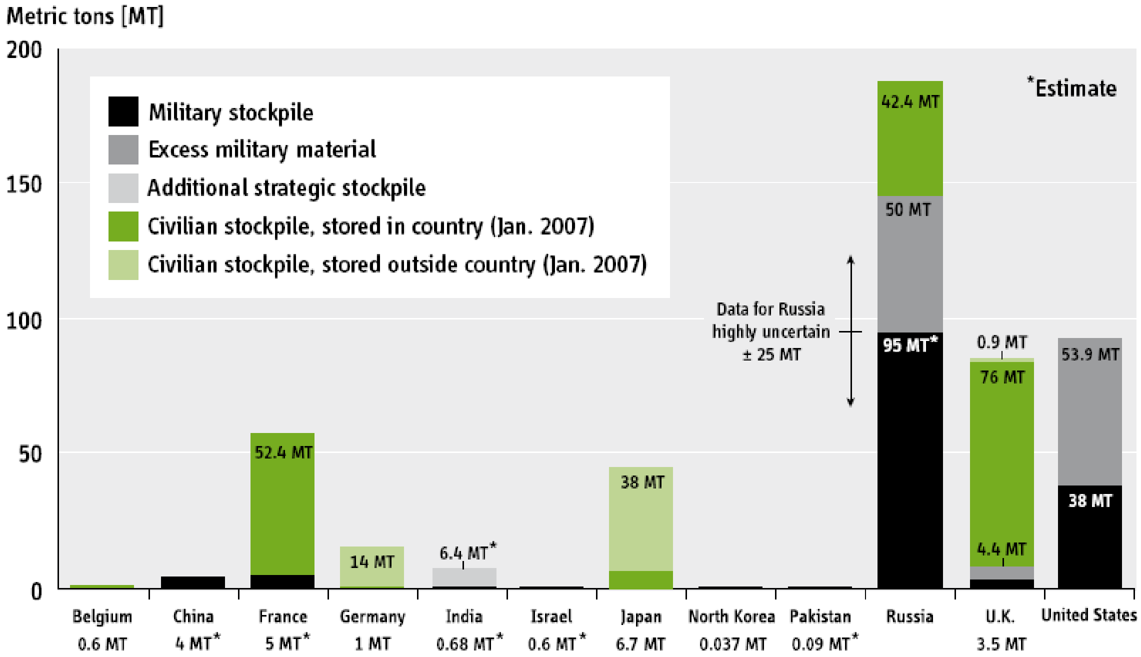

Figure 8. National Stocks of Separated Plutonium.[208]

While global quantities of HEU have undergone significant reductions, the global stockpile of separated plutonium will likely expand at least in the near term. Japan’s newly opened reprocessing facility at Rokkasho will generate a significant amount of separated plutonium until a mixed-oxide fuel (MOX) recycling facility can be constructed.[209] India, Pakistan, North Korea, Russia, Japan, France, the United Kingdom and possibly Israel each continue to separate plutonium for military and civilian applications.[210] As an indication of the rate of this trend, from 1996 to 2005, the global civilian plutonium stockpile grew from 170 to 250 metric tons.[211]

This inventory, while imperfect, provides a suitable baseline and a point of departure from which focal areas can be established and progress or deterioration measured. Considering the significant and widely distributed global inventory of nuclear weapons, HEU and plutonium, the proposition of effectively securing these materials

[208] International Panel on Fissile Materials, 2008, 16.

[209] International Panel on Fissile Materials, 2007, 13.

[210] International Panel on Fissile Materials, 2007, 14–17.

[211] Ibid., 16.

poses a challenge that may initially appear insurmountable. This analysis clearly highlights some of the most disconcerting factors involved. First, accounting and transparency for both materials and weapons are questionable and imprecise. Second, the continued production of nuclear weapons, HEU, and plutonium will not make the job of securing nuclear materials or preventing a terrorist nuclear attack any easier.

At the same time, this global inventory also demonstrates some factors that may suggest hope for efforts to secure fissile materials. To begin, the number of states in possession of weapons and fissile materials has been well constrained in the six decades since the technology's inception. Furthermore, most, but not all of the states involved are stable, well developed, and on reasonably amicable terms with the United States, cooperative with the International Atomic Energy Agency (IAEA), and provide a sufficient level security and transparency in their nuclear programs.

Despite the apparent breadth of this challenge, it appears relatively well defined and therefore suited for incremental measures undertaken to increase, but never guarantee complete accountability or security. Efforts undertaken to stop or limit the production of new materials, or locate, inventory, secure, consolidate or destroy existing materials will bear direct, immediate, and measurable impacts on improving the collective source security environment.

b. Acquisition Alternatives: State Transfer or Theft

Numerous scholars support the notion that the greatest hurdle preventing terrorists from conducting a nuclear attack is the difficulty of obtaining a state produced bomb or procuring enough fissile material to construct one.[212] An independent nuclear weapons program is normally discounted as a viable option since it would require an extensive and modern industrial complex, a staff of qualified scientists and other highly technical specialties, a secure environment to conduct a long-term production effort, and a financial commitment of billions of dollars.[213] Terrorists attempting to acquire a nuclear weapon or enough fissile material to fabricate their own would have to do so

212 For examples see Ferguson and Potter, 25, 34–35, Allison 92–93, and Cirincione, 141.

213 Younger, 139–146, and Ferguson and Potter, 119.

through state transfer or theft. For the purposes of this study, the options of state transfer and theft include any associated purchase arrangement. A purchase would necessarily result from either a theft or tacit state approval and therefore does not represent a uniquely differentiated acquisition scenario.[214]

Many view the likelihood of terrorists acquiring a nuclear bomb or fissile material through a state sponsor as remote for two primary reasons.[215] First, the numbers of state-produced bombs, especially those considered at greatest risk for diversion or theft, in countries such as Pakistan or North Korea, are relatively few.[216] States investing billions of dollars to achieve a weapons capability have significant economic and security interests in protecting their precious possessions. These critical national assets are normally stored in well-fortified facilities and heavily guarded by elite military units.[217] Second, advances in the forensic identification of nuclear materials make it highly probable that a terrorist nuclear attack would be traced back to a state of origin.[218] Considering the significant risk and scale of retaliation, a transferring state would need to be exceptionally desperate or irresponsible to contemplate an act with such great risks. In light of these factors, in 2001 the U.S. Department of Defense concluded that, "the likelihood of a state sponsor providing such a weapon to a terrorist group is believed to be low."[219]

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[214] Corera, 143-151, Author's Note: One might argue that the A.Q. Khan case runs contrary to this reasoning. After careful research, the author cannot support the notion that key figures in the Pakistani government did not have some knowledge of Khan's activities. This case therefore fits within the model established for this research.

[215] For examples see Ferguson and Potter, 57, Langewiesche, 19, and Thomas B. Cochran, and Matthew G. MicKinzie, "Detecting Nuclear Smuggling," *Scientific American*, Vol 298, Issue 4 (April 2008), 98–100.

[216] International Panel on Fissile Materials, "Global Fissile Material Report 2008," 8, and Ferguson and Potter, 55–57.

[217] Langewiesche, 19.

[218] Ferguson and Potter, 57.

[219] Ibid.

Despite clear incentives for states not to transfer nuclear weapons or materials to terrorists, some feel Pakistan may represent a case where the risk of state transfer may be the greatest.[220] The convergence of Pakistan's volatile domestic political situation and the Pakistani military's historic support for radical Islamists generates a compelling concern.[221] Whether a Pakistani leader could come to power who would be willing to support a transfer or a senior military member could act independently to provide a weapon, the implications would be significant. However, preventing such a transfer does not necessarily entail identifying or taking any action against a prospective terrorist recipient. In fact, measures taken that encourage or facilitate state responsibility may offer the best hope for success.

Ultimately, a state transfer of a nuclear weapon or material would require the participation of the state, or at least a senior state representative with adequate access and authority. Clearly communicated, state versus state deterrence policies and international assistance to improve security technology, methods, and infrastructure could increase security while concurrently increasing the costs and challenges faced by any terrorist seeking a transfer. By focusing on the actions and intentions of the state, the terrorists' influence in pressing for a state transfer could be significantly diminished without ever having to engage or even identify the terrorists. Terrorists unable to negotiate a transfer of a nuclear bomb or sufficient materials to construct one would be forced to abandon their pursuit or attempt to steal (or purchase from someone else who had stolen) enough fissile material to construct their own.[222]

According to the IAEA, between January 1993 and December 2006, there were 1,080 confirmed incidents involving nuclear or radiological material and criminal intent.[223] Of these, only 18 cases involved weapons-useable HEU or plutonium and none of any sizeable quantity.[224] While states such as North Korea and Iran instinctively raise

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[220] Allison, 77, and Ferguson and Potter, 55–57.

[221] Fergusson and Potter, 55.

[222] Bob Graham et al., 20.

[223] U.S. Government Accountability Office, GAO-08-999T, 2008, 4.

[224] Ibid.

suspicion due to their ties to terrorist groups, continued deception regarding their nuclear programs and inflammatory rhetoric, countries such as Russia and Pakistan may present the greatest opportunities for theft due to their unique geopolitical environments.[225]

The sheer quantity of material contained in the Russian nuclear stockpile combined with reports of less than adequate physical security and impoverished security forces susceptible to bribery or cooptation clearly support those who promote Russia as a likely target for nuclear theft.[226] While these observations and supporting statistics are used to advocate Russia's susceptibility to theft, they are equally effective in opposing this position. Despite Russia's massive stockpile, economic difficulties, security shortcomings, and track record of illicit trafficking incidents there is no evidence of there ever having been a theft of a significant quantity of weapons grade material or a weapon by a terrorist or any other party.[227] An improving Russian economy and greater political stability also offer compelling arguments to suggest that the period of greatest threat may have passed. Unfortunately, it would only take a single theft or transfer to negate this historical trend and ongoing examples of corruption and oligarchic power manipulation may pose some level of increased risk.[228]

Security concerns involving Pakistan's nuclear arsenal began to receive significant attention following the 9/11 attacks.[229] After two unsuccessful assassination attempts against President Musharraf, Russian President Putin publicly suggested that terrorists might be able to gain access to Pakistan's nuclear weapons.[230] To alleviate these concerns, the U.S. has provided extensive transportation, accounting, and state-of-the-art weapon authorization code system upgrades to assist Pakistan in enhancing its

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[225] Cirincione, 91, and Cochran and MicKinzie, 99.

[226] Ferguson and Potter, 55–59.

[227] Robin M. Frost, "The Nuclear Black Market," *Adelphi Papers* 45 (2005), http://www.informaworld.com/smpp/content~db=all?content=10.1080/05679320500519005, 17.

[228] David E. Hoffman, *The Dead Hand*, (New York: Doubleday, 2009), 191.

[229] Ferguson and Potter, 77.

[230] Ibid., 77–79.

weapons security.[231] While many security assistance details remain classified, by 2004, senior U.S. government officials were publicly stating their confidence in the steps taken to secure Pakistan's nuclear weapons.[232]

Both the Russian and Pakistani examples demonstrate the utility of cooperative U.S. efforts undertaken to provide security assistance coupled with each nation's own national interest in preventing the theft of their weapons and nuclear materials. If these states represent the worst-case examples, one could argue that the security enhancements already in place combined with the addition of future planned upgrades will only serve to extend the historic absence of any significant and successful theft. While this conclusion may be correct, security policy must account for emerging threats as well and cannot be solely predicated on the historical absence of an event. This absence may simply represent an untested avenue or an ongoing search for the right opportunity. This analysis supports two conclusions; one, cooperative and national security efforts are effective in preventing theft and two, they should not be exclusively relied upon but rather viewed as a piece of the larger, layered, defensive strategy.

c. Nuclear Bomb Construction, Transportation, and Use

While the acquisition of fissile material or a bomb is widely regarded as the most significant hurdle for terrorists to negotiate, bomb construction and delivery also pose formidable organizational, technical, and financial difficulties.[233] Assuming terrorists were successful in obtaining a sufficient quantity of fissile material, they would face considerable challenges involved with the construction, transportation, and detonation of an improvised nuclear bomb.

According to the IAEA, a nuclear bomb could be fabricated from as little as 25 kilograms of HEU or 8 kilograms of plutonium (weights roughly equated to the size of a melon and a plum respectively).[234] Terrorists would likely favor HEU for several

[231] Ferguson and Potter, 77–79.

[232] Ibid.

[233] Younger, 118, and Ferguson and Potter, 118.

[234] U.S. Government Accountability Office, GAO-05-375, 2005, 1.

reasons. Plutonium, being poisonous, radioactive and highly susceptible to oxidation, is extremely difficult to work with and much easier to detect by radiation screening apparatus.[235] Plutonium also cannot be used to fabricate the far less complex gun-type weapon.[236] In choosing a weapon configuration, terrorists could opt for either a gun-type or implosion-type. A gun-type weapon normally consists of an HEU slug fired at a known velocity into an HEU target sphere.[237] Some divergence of opinion exists regarding the simplicity of such a weapon. Stephen Younger, former director of DoD's Defense Threat Reduction Agency (DTRA), postulates that a gun-type weapon cannot be achieved simply by firing two HEU slugs at one another in an old artillery barrel, but instead must meet sensitive tolerances requiring complex machining and significant scientific oversight.[238] Conversely, Nobel laureate Luis Alvarez explains that a suicidal terrorist in possession of modern, weapons-grade HEU would stand a good chance of achieving a high-yield detonation by simply dropping one half of the material onto the other.[239] Despite this controversy, most authors agree that an implosion type-weapon requiring a nearly perfect, symmetrically timed detonation, would necessitate a degree of sophistication and competence beyond the capacity of virtually any non-state actor.[240] These factors together suggest that a terrorist would be far more likely to seek HEU as their primary choice of fissile material and pursue the fabrication of some form of gun-type weapon.

The next consideration would require a decision between assembling a weapon overseas and transporting it as one unit or smuggling pieces individually to be assembled once in the U.S. Assuming that some complexity exists beyond dropping one piece of HEU on another, a weapon sufficiently engineered to sustain the rigors of transportation and reasonably likely to produce a yield might be of a size and weight similar to that of the Little Boy gun-type weapon dropped on Hiroshima near the end of

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[235] Younger, 143-144, and Langewiesche, 21.

[236] Ferguson and Potter, 134.

[237] Allison, 96.

[238] Younger, 144.

[239] Ferguson and Potter, 132–133.

[240] For examples see Younger, 145–146, Allison, 96, and Ferguson and Potter, 135–138.

World War II. Little Boy was ten feet long, twenty-eight inches in diameter, and weighed nine thousand pounds.[241] A weapon of this size and weight would almost certainly have to enter the country through a land border crossing or through a seaport as cargo. This reality highlights the strategic importance of screening the millions of cargo containers that enter the U.S. each year and reinforces the significance of continuing to improve the process and develop better detection technology. The other alternative would be to smuggle in smaller components through cargo or drug and illegal immigration avenues of entry.[242] While this might be feasible, this approach introduces the complicating factors of having to find a secure location to assemble the weapon, obtaining the necessary machining equipment for fabrication, and fielding a large cadre of smugglers and personnel to build the weapon. This avenue would open up numerous opportunities for detection, any one of which could expose the plot. Whether transported as a single unit or in pieces, each method supports the notion that border security, cargo screening, and domestic law enforcement, intelligence, and public awareness might act as deterrents and serve to undermine or interdict either type of movement scenario. Considering the disproportionate complication of transporting several pieces and the subsequent assembly challenges, terrorists would likely find it much simpler to attempt to smuggle a fully constructed weapon in through a sea or land cargo container, which could then be employed immediately.

Detonating an improvised nuclear bomb represents the step most difficult to prevent. A properly constructed bomb could be activated by a suicidal terrorist, remote control or even a timer. The initiation would simply require the closure of a switch that would in turn apply power to fire the propellant bringing the two sub-critical masses of HEU together. This could even be accomplished through the actions of an unknowing victim turning on a light switch, driving over a pressure plate or other innocuous act electrically or mechanically linked to the bomb's firing circuitry. The only hope at this point is that the device is either detected prior to initiation with enough time to stop it or that the device fails to function.

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[241] Younger, 25.

[242] Allison, 115–116.

3. Threat Observations and Summary

This panoramic analysis of both the intent and capability of terrorists to acquire the necessary materials and conduct a nuclear attack reveals several key factors. Intent must be measured in degrees and in constant perspective of the necessary capabilities to conduct an attack. Each factor can be diminished individually or collectively to reduce the overall threat. While very few terrorists have expressed the intent to employ nuclear weapons against the U.S. or other states, even the remote chance of such an occurrence demands focused analysis and constant vigilance.

Intelligence will continue to play a pivotal role in estimating the intent and capability of nuclear-weapon seeking terrorists and identifying potential sources of nuclear material. However, historical failures in maintaining an accurate intelligence picture when only a few, slowly progressing state actors were involved strongly suggest that the ICs' ability to keep up with rapidly expanding sources across black markets, grey markets, terrorist networks, and increasing state proliferators is highly questionable, if not impossible. Due to the scope and seriousness of this threat, as well as the difficulties involved in generating accurate and timely information, intelligence should not be unduly relied upon to solve this dilemma. Broadly applied programs to deter proliferation, secure nuclear materials, and interdict materials in transit and at border crossings must continue to play a role in deterring or preventing a terrorist nuclear attack.

The sources of fissile materials range widely across the globe, the security of which varies considerably. These sources have expanded in the decades since the technology was conceived, and destabilizing security situations in East Asia and the Middle East could foment cascading proliferation throughout each region and beyond.[243] With such small quantities necessary to fabricate a bomb, it appears likely that terrorists at some point might plausibly receive or steal enough fissile to construct a crude nuclear bomb. While the U.S. pursues the goal of securing all fissile material, the likelihood of achieving this appears overly or perhaps hopelessly optimistic and reinforces the strategic importance of a layered defensive approach.

[243] Cirincione, 107–109.

Despite the disconcerting and ominous threat of a domestic nuclear terrorist attack, this analysis clearly shows that the risk factors of threat-intent and threat-capability can be reduced through the application of targeted mitigation techniques (Table 6). Within the risk equation, the threat of a domestic nuclear terrorist attack should be assessed as low with the caveat that it could be further reduced but likely never eliminated.

	Weapon Type	Material	Size/Weight of Components Moved Across the U.S. Border	Transportation and Manufacturing Challenges	Mitigation Techniques
Foreign Built Bomb	Gun-Type	HEU	10'x3'/9,000 pounds or larger[244]	Due to size and weight, likely brought in through a port, land border crossing, or maritime approach	HEU source security focus, Land and sea cargo screening and detection monitors, Increased maritime approach security
Domestically Built Bomb	Gun-Type	HEU	Numerous small pieces of virtually any weight	Large organization, avoiding detection during smuggling of disassembled components and during construction	HEU source security focus, Border, port and maritime security, domestic awareness, law enforcement, intelligence and surveillance
State Sourced Bomb Through Theft or Transfer	Implosion-Type	Plutonium	Worst case-60" x 40" x 20"/120 pounds divided between two containers[245]	International attention following early notification of theft	State versus state deterrence and security assistance programs

Table 6. Mitigation options for the most probable terrorist attack scenarios

[244] See Younger, 25. Weight and dimensions are based upon the Little Boy gun-type weapon. A crudely constructed terrorist device built without the support of state resources and a cadre of world-class scientists would potentially be larger and heavier.

[245] See Allison, 43–49. Weight and dimensions based on the Special Atomic Demolition Munition (SADM); a typical strategic or tactical implosion-type weapon would likely be larger.

B. VULNERABILITY ANALYSIS

A portrayal of vulnerability represents the likelihood that a terrorist attack is successful given that an attack has been undertaken. An assessment of vulnerability includes analysis of physical, administrative, and other operational attributes that depict a target's susceptibility to a given hazard.[246] For instance, a convenience store clerk might work behind a physical barrier of bullet-resistant glass. A prospective thief attempting to rob the clerk at gunpoint would likely be unsuccessful even after firing several rounds at the clerk. In this simplistic example, an attack is undertaken but unsuccessful due to a physical attribute that effectively counters this specific threat. The problem of mitigating vulnerability becomes dramatically more difficult when dealing with the massive destructive power of a nuclear detonation.

A nuclear detonation, not unlike that of a conventional explosive, releases an enormous amount of energy that translates immediately into heat and blast overpressure. In the case of a nuclear detonation, radiation is also released as a product of the reaction.[247] The initial explosive effects transition into secondary hazards including fire, building collapse, negative pressure wave, flying debris, and radiological fallout.[248] Assuming an attack has occurred, distance and protective works, such as subsurface construction, represent the primary methods for reducing the effects of heat and blast. The U.S. has employed target-hardening techniques in the construction of nuclear missile silos, as well as protective shelters for key governmental personnel.[249] However, due to excessive costs, relatively small protective footprint, and the complexity of construction and subsequent access, these types of protective works are not practical for most public or private applications.

246 U.S. Department of Homeland Security, "National Infrastructure Protection Plan," 2009, 36.

247 Allison, 4.

248 Langewiesche, 7–10, and Ferguson and Potter, 51–53.

249 Bruce G. Blair, John E. Pike, and Stephen I. Schwartz, "Targeting and Controlling the Bomb," in *Atomic Audit*, ed. Schwartz, 214.

On February 26, 1993, terrorists detonated 1,400 pounds of fertilizer-based explosives in the underground parking garage of the World Trade Center.[250] The attack did not cause the building to collapse as planned; however, six people were killed and over a thousand injured in this attack.[251] On April 19, 1995, Timothy McVeigh detonated a truck loaded with 5,000 pounds of fertilizer-based explosives outside the Alfred P. Murrah Federal Building.[252] One hundred sixty-eight people were killed in the ensuing blast and nearly half of the nine-story building crumbled to the ground.[253] The Khobar Towers bombing on June 25, 1996, also employed an estimated 5,000 pounds of explosives packed into a fuel truck and detonated outside a U.S. military housing complex in Riyadh, Saudi Arabia.[254] The blast killed 19 U.S service members, injured 372, and brought down a significant portion of the eight-story building.[255] By comparison, a crudely constructed 10-kiloton weapon would vaporize everything within a one-third mile radius and destroy virtually every structure within a one-mile radius.[256] A larger 20-kiloton weapon, similar in size to that dropped on Hiroshima or Nagasaki, would damage or destroy most buildings in any modern city and kill everyone within a 10-square-mile footprint.[257]

The vast majority of infrastructure is simply not built to withstand a nuclear detonation. Population centers, dams, bridges, power plants and other infrastructure would all be subject to significant damage or destruction following a nuclear attack. A nuclear attack would have an enormous destructive capacity and once initiated would likely be viewed by terrorists as a success in virtually any setting and by any standard of measure. The physical features of modern society render it exceedingly susceptible to

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250 Thomas C. Reed and Danny B. Stillman, *The Nuclear Express* (Minneapolis: Zenith Press, 2009), 6.

251 9-11 Commission, 71.

252 Jennifer Rosenberg, "Oklahoma City Bombing," About.com, 20th Century History, http://history1900s.about.com/cs/crimedisaster/p/okcitybombing.htm.

253 Ibid.

254 GlobalSecurity.org, "Khobar Towers," http://www.globalsecurity.org/military/facility/khobar.htm.

255 9-11 Commission, 60.

256 Allison, 4.

257 Cirincione, xi.

this hazard. At the same time, the cost of comprehensive hardening to mitigate this vulnerability is cost-prohibitive and impractical at virtually any degree of implementation. In this regard, one must depict the vulnerability factor in the risk equation as both high and fixed. Any effort to minimize the risk of a nuclear terrorist attack will not be achieved by reducing vulnerability.

C. ANALYSIS OF CONSEQUENCES

As explained in the NIPP, the level, duration, and nature of loss collectively represents the consequences of a nuclear terrorist attack.[258] More specifically, health and safety, economic, psychological, and governance impacts provide the quantitative benchmarks for an assessment. Clearly, a domestic nuclear terrorist attack would generate enormous effects across all of these areas resulting in extremely grave consequences. The precise consequences of an attack would derive from factors such as the location, time, and yield of the detonation. The nuclear detonations in Nagasaki and Hiroshima fail to provide an effective representation of consequences because each was an airburst and in an environment that predated the current structural and technological advancements and dependencies.[259] While no example can provide a directly comparative estimate, enough data exists regarding the effects of nuclear and conventional detonations, radiological impacts, mass casualty events, and governmental responses to draw substantive conclusions.

In any major city, a nuclear detonation in the 10 to 20-kiloton range would instantly kill hundreds of thousands, possibly even millions of citizens.[260] The effects of fire and radiation would ravage survivors within a mile-and-a-half radius and cause significant damage out to three miles or further.[261] The 1986 explosion and subsequent

[258] U.S. Department of Homeland Security, "National Infrastructure Protection Plan," 2009, 34–35.

[259] Robert C. Harney, "Inaccurate Predictions of Nuclear Weapons Effects and Possible Adverse Influence on Nuclear Terrorism Preparedness," *Homeland Security Affairs Journal* Vol V, No 3 (September 2009) http://www.hsaj.org/?fullarticle=5.3.3, 1. The most likely terrorist nuclear attack would be conducted at ground level. However, even a detonation at the top of a high rise would not approximate the effects of a true airburst.

[260] Cirincione, xi and Reed and Stillman, 6.

[261] Allison, 4.

fire at the Chernobyl nuclear power reactor provides some illustrative examples of potential radiological impacts. Due to the released radioactive materials, 350,000 people were forced to evacuate and permanently resettle. Estimates suggest that tens of thousands of cancer deaths will occur in those exposed to the fallout.[262] This event caused an estimated $300 billion in damage without any associated nuclear explosion. The 2001 attack on the World Trade Center represents another contemporary model useful for depicting a fraction of the economic impact that could be expected in the aftermath of a domestic nuclear terrorist attack. One source suggests the measurable costs of the attack and subsequent response measures currently exceed $2 trillion and continue to grow.[263] A nuclear detonation, causing physical and environmental damage many times greater would obviously generate an unparalleled and possibly unsustainable economic impact.

In addition to the loss of life and economic damage, Americans would live in fear of another, similar terrorist attack. Such an attack could easily erode public confidence in the government and wreak havoc across the national political landscape. The government might respond with harsh security measures in an attempt to prevent follow on attacks. History has shown through examples like the World War II internment of Japanese Americans, the U.S. rendition program for terrorist suspects, and the FBI's domestic counter-intelligence program (COINTELPRO) activities, that some drastic measures taken to inspire public safety and confidence may be counterproductive. Possibly the most significant impact could result from self-inflicted costs following an attack. Some suggest that the 9/11 attacks have drawn the U.S into a self-defeating spiral of fear, exaggerated response, and wasteful spending that far exceed the direct impacts of the actual attack.[264]

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262 Allison, 7.

263 Institute for the Analysis of Global Security, *How Much Did the September 11 Attack Cost America?* 2003, http://www.iags.org/costof911.html and Lustick, 23.

264 Lustick, ix.

The consequences of a domestic nuclear terrorist attack would cause enormous effects across the U.S. and around the world. Without any effective means of minimizing the consequences of a nuclear attack, this factor in the risk formula should be assessed as unalterably high.

D. RISK ANALYSIS AND CONCLUSIONS

Through this analysis of threats, vulnerabilities, and consequences, attributes have emerged that suggest areas where resources should be focused to reduce the risk of a domestic nuclear terrorist attack, as well as areas where additional investment would result in little or no security improvement or risk reduction (Table 7). Despite the demonstrated inability to lower the vulnerability and consequence risk factors, any reduction in the threat through various means would result in a corresponding decrease in risk.

	Threat-Intent	**Threat-Capability**	**Vulnerability**	**Consequence**
Assessment	**Low**-few groups interested in mass casualty event and assured retaliation	**Low**-financially, organizationally and technically demanding	**High**/Fixed	**High**/Fixed
Mitigation Opportunities	Coalition based deterrence by punishment, deterrence by denial measures to increase costs, normative behavior shaping	Deterrence by denial: Increased source, border, port and maritime security measures, more stringent material control measures	None	None

Table 7. Summary of Risk Analysis and Mitigation Opportunities.

Accurate intelligence can and must play a key role in focusing efforts directed at curtailing or manipulating the intentions of terrorists. Targeted efforts have the capacity to shape terrorists' intentions from inception all the way up to the point of the actual attack. At any point along this continuum, preventive efforts may overcome the terrorists' intentions and end or redirect the pursuit. Deterrence by threat against a non-state actor is most credibly applied by a broad coalition committed to employing force in response to a reasonably established threat. The deterrent effect typically increases as the capacity and credibility of violence grows. Deterrence by denial represents the cumulative effects of all the strategic layers of security. The combined impact of source and border security, technological advances, law enforcement, intelligence, and other measures create costs and difficulties forming a defensive structure that effectively dissuades terrorists from a given pursuit. The final factor influencing terrorists' intentions is that of normative behavior standards. Here, the most advantageous factor is the lack of an historic precedent; however, the inclusion of Islamic states in an opposing coalition of enforcing states will bolster this position enormously. Each of these denial measures seeks to encourage the terrorist to decide of his own accord not to pursue a domestic nuclear attack.

In diminishing the capability of terrorists to conduct an attack, every additional increment of source security is invaluable. Sources are widespread and while relatively safe, certainly not secure enough to provide complete assurance. Additional security should be applied at every opportunity, but other layers of security must be employed in conjunction to counter any potential leaks. State versus state deterrence and supportive security assistance efforts offer a carrot-and-stick approach to encourage and aid states in policing their own actions and increase the difficulties faced by terrorists shopping for a sponsor. If done effectively, this will force terrorists toward the alternative acquisition method of theft, which would likely result in timely reporting and corresponding interdiction efforts. Fortunately, the historic record of nuclear weapon or fissile material theft does not support an assessment of extreme vulnerability. Steadily improving security will only increase the costs and difficulties associated with this approach. Despite these optimistic indications, theft should not be ruled out as a possibility.

Shaping the threat environment does not necessarily entail defeating the enemy or completely removing a threat capability. Instead, it allows a defender to apply targeted measures that force his adversary to either abandon a course of action or follow a path dictated by the defender that creates more difficulties for the attacker or is more easily detected and defended against. For instance, instead of pursuing the goal of securing every kilogram of fissile material, one might instead opt to start by focusing resources on securing as much HEU as possible. This could appear to recklessly neglect plutonium security, but this strategic decision might force a prospective terrorist to reconsider his plans in light of the technical challenges associated with the fabrication of an implosion weapon, the more toxic production environment and the increased ability to detect the materials with border and port screening apparatus. Within the context of overseas source security, measures should prioritize the importance of weapons first, then HEU next, due to its unique suitability for improvising a nuclear bomb.

In an overall assessment of the threat environment, the transitory security efforts fall short in comparison to the domestic and overseas source security capabilities. As a result, a weakness is created by this imbalance that could be viewed by terrorists as an opportunity. An imbalance or weakness in any area can increase terrorists' threat-intent or threat-capability unless recognized and corrected. A foreign-assembled weapon scenario emphasizes the importance of port and border cargo screening and detection while a domestically assembled weapon reinforces the significance of domestic law enforcement, intelligence, and better policing of cross border smuggling avenues. In either instance, an increased emphasis is warranted in these areas that represent the weakest layer in the overall security architecture. As the weakest layer, transitory security measures also represent the area where the greatest opportunity for improvement exists.

Vulnerability and consequences are fixed, but threat-intent and capabilities offer opportunities where preventive measures and resources can be focused to increase security and reduce risk. The inability to negate any single aspect of the threat depiction in its entirety demands that a layered strategy be employed to afford the best chance of preventing an act of domestic nuclear terrorism. Through a diversified approach,

significant aspects of each threat factor can be reduced resulting in synergistic effects. In the end, the prospect of pursuing a nuclear weapon should remain too dangerous, costly, or complex to represent a worthwhile investment for terrorists. The assortment of preventive measures does not need to be equally funded or effective. The collective effort must, however, be coordinated sufficiently to shape the operating environment facing terrorist actors. A well-coordinated and implemented strategy should apply pressure on the terrorists, forcing the most motivated groups toward the most difficult and detectable means of attempting to gain a nuclear capability or out of the game completely. As either or both of the threat intent and capability factors are reduced, the resultant risk of a domestic nuclear terrorist attack is also lowered.

Proactive overseas source security measures do not hold a disproportionate degree of efficacy in reducing the threat of a domestic nuclear terrorist attack. While poor foreign source security is not desirable, complete foreign source security is likely not achievable or verifiable. Accepting that proactive overseas source security is not a panacea and that other programs offer less quantifiable but critically important influences on threat-intent and threat-capabilities, a balance is clearly necessary that reflects this operational landscape.

This threat analysis delineates some important nuances in calibrating the resources afforded to preventive programs within a preventive strategy. The importance of securing domestic sources becomes increasingly apparent since a case of domestic theft or transfer would bypass numerous other layers of security. Of equal importance, a case of domestic acquisition might also shorten the overall timeline leading to an attack thereby reducing the amount of time available to detect and prevent an attack. Land and sea cargo as well as general border security measures are lacking by any measure and must be afforded a higher resource prioritization and strategic emphasis.

While this chapter might appear to draw conclusions that are somewhat expected, the primary significance lies in the contradictions found between the risk perspective herein and the relative effectiveness of preventive measures discussed in chapter II. The research in Chapter II, as well as the position of numerous scholars, suggests that proactive, overseas source security measures hold the greatest promise for achieving

heightened national security.[265] In contrast, the risk analysis in this chapter reinforces the importance of pursuing a layered defensive strategy that balances each preventive effort within a strategic plan that can effectively shape the threat environment to the defender's advantage.

[265] For examples, see Bunn, v, Ferguson and Potter, 25, 34–35, Allison 92-93, and Cirincione, 141.

IV. ANALYSIS OF THREAT RESPONSE PROGRAMS AND RISK

Numerous prominent scholars and U.S. government officials have repeatedly emphasized the importance of securing foreign nuclear weapons and fissile materials at their source as the first and most effective component in a strategy to prevent a domestic act of nuclear terrorism.[266] This emphasis is based upon the widely promoted contention that acquiring a nuclear bomb or sufficient material to construct one represents the greatest barrier preventing a terrorist nuclear attack.[267] Despite the popularity of this opinion, analysis of the current programmatic appropriations in Chapter II reveals that preventive resources are broadly distributed across programs that have proactive, reactive and crosscutting foci without any disproportionate fiscal significance afforded to securing foreign sources of nuclear bombs or fissile material. To address this prominent and potentially significant contradiction, this analysis seeks to determine if resources should be recalibrated to direct more emphasis toward foreign source security efforts or other focal areas in order to reduce the risk of a domestic terrorist nuclear attack. By comparing the effects of current programs that seek to prevent a domestic nuclear terrorist attack with the most plausible risk factors and resultant mitigation opportunities, estimates can be derived that suggest where resources and emphasis are adequate and where additional resources might provide a heightened degree of national security.

Instead of relying on the often used and somewhat capricious foreign versus domestic expenditure or interdepartmental funding comparisons, this chapter will explore the more telling intersection between the program focus and effectiveness matrix developed in Chapter II and the risk mitigation perspective depicted in Chapter III. Specifically, this chapter will analyze the inter-relationships between the main preventive programs and the potential for each to reduce the risk factors of threat-intent and threat-capability. This analysis concludes that overseas proactive source-security measures are adequately funded to the extent necessary to keep pace with the current employment

[266] For examples see Bunn, v, Ferguson and Potter, 25, 34–35, Allison 92–93, and Cirincione, 141, Obama.

[267] Younger 118, 146.

opportunities enabled by diplomatic progress. Similarly, the research demonstrates that domestic proactive source-security programs are both capable and sufficient. Most notably this research finds that while reactive security measures offer some of the least tangible benefits, they represent the security layer most in need of increased funding and emphasis. Unless steps are taken to address this deficiency, the Global Nuclear Detection Architecture will be unable to effectively counter today's threat or prepare for tomorrow's.

A. PROACTIVE OVERSEAS SECURITY MEASURES AND RISK EFFECTS

The primary efforts that provide proactive overseas source security emphasis include the DOE's MPC&A and DoD's CTR programs. Collectively, these programs account for nearly $540 million or 19 percent of the $2.8 billion Global Nuclear Detection Architecture's annual appropriation.[268] These programs have the potential to rapidly provide quantifiable and direct increases in security, consist of mature technologies, and are more difficult to circumvent than most current reactive security measures. Timing and responsiveness play a significant role in the efficacy of these source-security programs. When political and diplomatic efforts open a window of opportunity to aid in securing foreign sources of fissile material, the U.S. should be prepared to act with a sense of urgency. Any delay in implementation simply provides an additional and unecessary opportunity for terrorists to acquire a nuclear capability.

From a risk perspective, these programs influence both the threat-intent and threat-capability factors making them particularly valuable in shaping the overall threat environment and reducing risk. These measures diminish the threat by increasing the difficulties and costs incurred by terrorists seeking to acquire a nuclear bomb or fissile material. These well-publicized international efforts may also deter terrorists through the reinforcement of socially acceptable normative behavior and the stigma attached to the illicit pursuit of nuclear materials. In addition, these programs influence terrorist activity by making select targets more difficult and, therefore, less desirable than others. As source security measures become more formidable and comprehensive, terrorists face the

[268] Shea, 14.

decision of pursuing an increasingly well-guarded objective or foregoing the nuclear option in favor of another less risky alternative. While the importance of source security programs and their impact on the threat environment are of paramount importance, challenges preventing their full implementation and continued reliability greatly diminish their utility as the linchpin of an effective security strategy.

Beyond the clear inability to adequately and permanently secure all fissile material, there are additional obstacles that plague source-security efficiency. Currently, the segregated application of source-security responsibilities, divided between the DOE and DoD, creates conflicting security prioritization, methodologies, and measurements of effectiveness. The lack of a centralized leadership postion with statutory staffing and budgetary authority affects more than just the proactive overseas security programs. This void of consolidated management generates inefficiencies across the entire Global Nuclear Detection Architecture and must be corrected before the full utility of the preventive architecture can be realized.

Since overseas security programs are funded by U.S. taxpayer dollars and executed on foreign soil, they are often mired in beaureaucratic debate that slows or prevents implementation. U.S. politicians have faced the challenge of justifying the investment in Russian nuclear security while potentially freeing Russian resources for use in weapon modernization programs.[269] Others have argued that despite this potential drawback, the money invested in source security should be viewed as a direct contribution to national defense and worth every dollar.[270] Considering both perspectives in this debate, the net effect of enabling some minimal level of Russian weapon modernization in order to gain the opportunity to apply vital source-security measures appears far more desireable than simply walking away and letting the situation unfold without U.S. involvement. By comparison, the prospect of dealing with a nuclear-armed Russia is far more manageable and familiar than with nuclear-armed terrorists.

269 Younger 135–136.

270 Ibid., 151.

Diplomatic barriers also play a role in reducing the effectivness of source-security programs. Unfortunately, the capability to act does not lie exclusively within the purview of the U.S. government. Assistance offered to other states has been delayed or rejected due to foreign national security, pride, and a host of other reasons. The outcome of this arrangment simply means that despite good intentions, the ability to implement overseas security measures cannot be conducted solely at the discretion of the U.S. government. While Russia has been surprisingly cooperative, it still maintains sites that remain off-limits to U.S. security assistance programs. As an additional hindrance, many countries such as North Korea and Iran provide little or no access and are not expected to do so in the forseeable future. Although this may represent a somewhat obvious limitation, it is an important factor to consider in balancing the application of preventive resources. While potentially less effective in some regards, U.S. border, port, and internal security measures can be implemented without the same constraints.

A final argument against over-reliance on source-security programs lies in their long-term efficacy. Physical-security measures are only as reliable as the personnel responsible for their employment. State-of-the-art U.S. security apparatus can be installed virtually anywhere, but without proper training, operation, maintenance, and oversight the systems are virtually worthless. This reality could come to bear in Russia, where economic incentives or institutional corruption might convince a security official to steal or circumvent security protocols in order to acquire fissile material.[271] Similarly, in Pakistan, political unrest and ties to religious fundamentalism might encourage a security member to aid in the theft of nuclear materials. In either case, the U.S. cannot and should not become over reliant upon source-security measures implemented on foreign soil by foreign security agencies to ensure domestic security.

Although proactive overseas programs offer a substantial capacity to increase security and reduce the risk of an attack, they have not and likely will not ever be capable of accounting for every nuclear weapon or weaponizeable quantity of fissile material. There are too many holes in transparency, accountability, and long-term efficacy to

[271] Hoffman, 191.

justify over reliance on foreign source-security programs as the predominant method of defense. Clearly, source-security measures represent a vital element in the overall preventive strategy and an invaluable tool for shaping the threat environment. However, despite the contentions of many scholars and politicians, overseas source-security measures do not represent a unitary solution capable of preventing an act of nuclear terrorism and should not be disproportionately funded or relied upon in an unrealistic attempt to achieve this end. These programs currently receive the funding necessary to keep pace with the opportunities created through diplomatic negotiations.

B. PROACTIVE DOMESTIC SECURITY MEASURES AND RISK EFFECTS

The DOE is tasked with providing security for the domestic nuclear complex. With an FY07 annual appropriation of $846 million, this pursuit represents the largest single category of preventive investment at 30 percent of the $2.8 billion Global Nuclear Detection Architecture budget.[272] These collective efforts seek to ensure the security of nuclear materials at domestic operating locations, laboratories, storage facilities, and in transit. Without the burden of diplomatic bureaucracy and international sensitivities, these programs can typically be modified and enacted on a much faster and predictable timeline than their overseas equivalents. Furthermore, the effects of these programs can be easily observed and quantified. The efficacy of these programs results from their management by a single agency, domestic oversight and implementation, and the direct results achieved through source security improvements.

The risk mitigation effects of domestic proactive security measures are significant but potentially undervalued in their role in preventing a domestic nuclear terrorist attack. Terrorists seeking to carry out a nuclear attack may perceive the complexity and difficulty of smuggling a nuclear bomb or fissile materials into the U.S. as too difficult or risky. The only alternative would be to acquire the bomb making materials domestically. If a terrorist were able to acquire a bomb or fissile materials in the U.S., he would effectively bypass many of the layers of security that collectively form the defense that the national strategy relies upon. This consideration elevates the relative importance of

[272] Shea, 14.

domestic nuclear security and justifies the greater proportional investment afforded to this effort. From a threat perspective, a robust domestic nuclear security program reduces the capability for terrorists to acquire fissile materials. It can also influence their intent by increasing the difficulty and cost of pursuing the acquisition of materials within the U.S. and force the consideration of the alternative cross-border movement risks.

While historically very successful, domestic proactive security is not without its own challenges. The effectiveness of domestic source-security efforts not only plays a role in deterring and preventing theft or diversion of nuclear materials for terrorist use, it also plays a pivotal role in communicating reliability and credibility to other states. A successful theft of a nuclear bomb or fissile material in the U.S. could quickly call into question the legitimacy of U.S. programs to implement heightened security measures at foreign locations. Ultimately, a domestic security breach could jeopardize the continued application of overseas security measures resulting in increased opportunities for terrorists to acquire and move nuclear materials. Furthermore, a successful theft of domestic nuclear materials could encourage other terrorists to attempt the same course of action and result in the demand for dramatic and costly increases in domestic security. For these reasons, the impenetrable security of domestic nuclear materials is of paramount importance.

Other challenges in the domestic security environment result from complacency and political infighting for the distribution of resources and jobs among constituencies. Each of these influences can serve to delay the dismantling of weapons and consolidation of fissile material and ultimately reduce the level of domestic nuclear security from what could otherwise be achieved without these obstructions.

These factors reinforce the necessity for an impenetrable domestic nuclear security system and substantiate the level of investment in domestic source-security. When analyzing how to best apportion resources to prevent a domestic nuclear terrorist attack, it should be remembered that if the U.S. cannot protect the materials within its own borders first, then in all likelihood it should not be relied upon to aid in the protection of other states' nuclear materials.

C. REACTIVE SECURITY MEASURES AND RISK EFFECTS

Reactive security programs represent a broad compilation of efforts dispersed among the DOE, DoD, DHS, and DOS, that seek to aid in the detection and interdiction of nuclear materials at foreign and domestic borders and ports. With a collective annual appropriation of $609 million in FY07, these programs constitute 22 percent of the total Global Nuclear Detection Architecture budget. The division of responsibility between departments is somewhat vague and has resulted in the utilization of various types of screening equipment, methodologies, and differentiated prioritization of security measures. Programatically, these efforts fall short in providing substantive or quantifiable measures of effectiveness.[273] Many of the programs rely upon immature and ineffective screening and detection technology. Many also rely exclusively upon foreign security agents to operate U.S.-provided detection equipment and effectively enforce cargo screening protocols. The disjointed application of these efforts allows numerous avenues for terrorists to circumvent each security measure, not the least of which is simply crossing over unsupervised border areas. Based upon these considerations, these programs currently offer a deterrent and defensive value that is difficult to quantify. This limitation becomes especially important when attempting to justify the quantity of resources invested in them.

On the other hand, despite the general inability to precisely measure their contributions, reactive programs have been shown to enhance the security architecture in some significant ways. The port and border crossing security and law enforcement entities included in these programs offer fine-grained local intelligence, similar to that which normally leads to drug and other types of smuggling interdiction.[274] The U.S. and foreign cooperative relationships formed during the implementation of overseas port and border security assistance programs have resulted in numerous cases of nuclear smuggling interdiction, clearly proving there is some direct and synergistic value to these efforts.[275] The continued creation and sustenance of international law enforcement and

[273] U.S. Government Accountability Office, GAO-05-375, 2005, 1, 2, 23.

[274] Allison, 181–182.

[275] U.S. Government Accountability Office, GAO-08-999T, 2008, 11.

intelligence relationships improve detection and counter-smuggling capabilities and convey a sense of collective resolve to deter terrorist actors. While difficult to quantify, these relationships increase deterrence by denial and threat through their implementation.

Quantitative analysis of the security contribution provided by reactive programs is less than conclusive. However, when the impact on the threat-intent and threat-capability is considered, the value of these programs becomes more prominent. Random or intermittent cargo screening and nuclear detection measures provide a deterrent effect, that aids in shaping the threat environment to the defender's advantage. Although current screening and detection technology may be immature, it represents a crucial first step. While this technology continues to be refined and improved by defenders, it may be much more difficult for terrorists to test and improve their nuclear smuggling capabilities to the same degree or at the same pace. Despite the currently low likelihood of nuclear materials being detected in transit, terrorists may not wish to risk the seizure of their invaluable cargo by attempting a movement through a protected port or border crossing. Further contributing to the deterrent effect, interdiction of nuclear materials in transit shown to have a terrorist nexus would likely lead to some measure of undesireable retribution. For a terrorist, these factors may force the consideration of the alternative complexities involved in moving fissile material or a nuclear weapon in smaller, disassembled pieces and ostensibly by a larger contingent of participants, each opening additional windows for detection and interdiction.

Domestically, one could surmise that more effective cargo screening might drive terrorists toward utilizing unprotected border crossings. It may, but it also allows defenders to shape the threat environment and influence the terrorists' planning factors. If the standard sea, air, and land cargo avenues are sufficiently protected to deter terrorists' use, this would likely force a prospective nuclear terrorist to transport a bomb in smaller components for subsequent assembly within the U.S. Improved domestic screening, surveillance, intelligence, public awareness and better security across ungoverned border regions could each play a role in tightening this security gap. Furthermore, enhanced border security would provide secondary benefits stemming from an increased capability to interdict illegal drug and immigrant flows. Collectively, these

efforts might also slow the timeline of an impending attack. As opposed to a complete weapon being brought in as cargo, a weapon requiring assembly would necessitate more time to prepare. This would offer authorities more time to detect and interdict a terrorist plot. More efficient sea, air, and land cargo security increases the costs and difficulties faced by terrorists and in this regard favors the defender and aids in shaping the actions of the adversary.

While far from perfect, even minimally capable reactive security measures introduce a significant consideration that prospective nuclear terrorists would have to weigh when deciding upon a course of action and estimating their chances of success. Reactive security measures provide a valuable threat-mitigating influence that belies the frequently disparaging assessment of their quantifiable utility. An increased application of resources toward these efforts will enable the strengthening of relationships in the international security arena and allow detection and interdiction tactics, techniques, and procedures to be refined and improved upon. If these efforts are dismissed as worthless due to their sporadic application and incomplete effectiveness, the other less tangible benefits and any future advancement in these pursuits would be lost.

As previously discussed, the effects of deterrence lies in the mind of the adversary. These measures provide direct results as evidenced by the sucessful instances of interdiction, but more importantly, they can introduce a sense of risk, vulnerability, and doubt in the mind of terrorists attempting to move the materials necessary to construct or employ a nuclear bomb. This ability to manipulate terrorist's intentions and actions must be retained, developed, and harnessed as an element of an effective layered strategy. As a final observation, reactive programs that encompass transitory security efforts represent the architectural layer where the greatest room for improvement exists. The application of additional resources in this area could directly reduce the threat if more capable detection systems were developed and fielded and borders were more substantially monitored and secured. Both the intent and capability of terrorists to pursue a nuclear attack could be reduced if a strengthened ability to prevent cross-border and cargo movement of fissile materials was implemented.

D. CROSSCUTTING MEASURES AND RISK EFFECTS

Crosscutting security programs primarily include research, development, test, and evaluation (RDT&E) initiatives, as well as U.S. and foreign training programs generally applicable to preventing nuclear smuggling and terrorism. These programs are administered by several departments, and collectively received a $577 million budget in FY07. This figure represents 21 percent of the annual Global Nuclear Detection Architecture's appropriation. One might first notice that the funding for these programs in FY07 exceeded that of the proactive source-security programs by some $37 million. While the budget figures vary slightly from year to year depending on the progress and completion of specific initiatives, to even suggest that these efforts are deserving of equal fiscal attention opens room for discussion.

RDT&E and training initiatives do not generate easily or immediately quantifiable increases in physical security, however, they do contribute to the continued success and improvement of the overall campaign to prevent a domestic act of nuclear terrorism. RDT&E of new technological systems to aid in the detection and identification of nuclear materials moving through ports, border crossings, and other transitory avenues is proportionately more costly than simply implementing and maintaining security measures consisting of mature technologies. Furthermore, detection and screening RDT&E efforts have been fraught with setbacks due to the scope and technological difficulty of the task. However, without continued investment to improve detection capabilites, little or no mass screening progress will occur in the reactive security environment. Training, on the other hand, represents an investment in the human capital that underlies every security system and method employed to prevent a nuclear terrorist attack. Without continued investment in the education of security personnel, their effectiveness will decline and each element of the security architecture will suffer. Termination or reduction of the funds applied to RDT&E or training would effectively forfeit the potential for future technological progress and jeopardize the current implementation of every layer in the Global Nuclear Detection Architecture.

E. ADMINISTRATIVE OVERHEAD

Administrative overhead represents the cost of doing business in any operation. In FY07, the overhead expense amounted to $231 million or 8 percent of the total Global Nuclear Detection Architecture budget. At first glance, this level of investment may seem excessive. However, the cost of facilities, transportation, computers, paper, pens and other general support requirements, dispersed among locations around the globe, quickly add up. In analyzing the calibration of the proportional resource distribution among Global Nuclear Detection Architecture programs, this category can be viewed simply as a necessary operating expense, and largely removed from further deliberation.

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V. CONCLUSIONS AND RECOMMENDATIONS

In a world where thousands of tons of weapons-grade plutonium and uranium are stored in dozens of countries, at hundreds of facilities, and protected by tens of thousands of custodians, the relative likelihood that terrorists, at some point, will acquire enough material to make a bomb is both threatening and plausible. When an amount of HEU the size of a melon is sufficient to fabricate a crude nuclear bomb, the challenge of designing effective security measure becomes increasingly obvious. Accepting that foreign source-security or any other measures alone will never be capable of providing a complete assurance of safety, the importance of the collective effects of all the layers of defense in shaping the threat environment is apparent.

When considering the goal of preventing a single domestic nuclear terrorist attack and the potential consequences of failure, one might argue that this threat merits the application of as much fiscal attention as necessary to guarantee success. Unfortunately, U.S. resources are constrained and the national budget must balance the importance of guarding against the threat of nuclear terrorism against all other defense, social, international, and other demands for federal funds. An overly simplistic recommendation to solve the problem by simply increasing funding across the board would likely not generate a proportionately greater capacity to reduce the threat of nuclear terrorism. It would represent an approach that fails to take into account the more important and necessary question of where and how to focus the application of resources. It would also be fiscally irresponsible, especially in light of the current economic difficulties, to apply additional resources toward this threat without fully understanding where and how the resources should be applied to generate the most productive results. Finally, haphazardly applying additional resources to comparatively strong areas of security only serves to highlight and increase the proportional weakness of other less well protected areas. The terrorist threat is fluid and responses must be tailored and funded to meet this reality. Overall funding may grow and decrease over time, but regardless of quantity, distributing

the resources among programs integrated under a well-conceived and managed strategic umbrella represents the most pressing challenge in managing the threat of nuclear terrorism.

Each preventive program plays a significant role in complementing the weaknesses of others and dictating the operating environment faced by the terrorists. In answering the ultimate question of how to calibrate the resources applied to preventive programs in order to minimize and shape the threat of a domestic nuclear terrorist attack this research supports three main conclusions. First, the prioritization of programmatic importance should recognize the primacy of domestic nuclear source-security followed by overseas source-security, U.S. border security and cargo screening, and finally, overseas reactive security measures. Second, the comparative weakness of reactive security measures including U.S. border and cargo screening measures as well as other external transitory security programs represent a disproportionate vulnerability that must be acknowledged and addressed through the application of additional resources. Third, the proportional distribution of resources cannot reflect a static approach to countering this threat. The fluid nature of terrorist activity demands the flexibility to shift resources to various applications as the threat evolves and adapts to existing security measures. In addition to the three main conclusions, this research provides an ancillary recommendation that may facilitate or enhance the application of measures taken to rectify the identified areas of weakness.

A. PRIMARY CONCLUSIONS

1. Prioritization of Threat Response Measures

The first step in determining the proper calibration of resources must be to determine an order of importance among preventive efforts. The importance of any preventive effort should not be minimized based solely on its ability to produce immediate, tangible security results. In evaluating the utility and importance of individual preventive efforts, a holistic perspective is required to see the importance of each component within the overarching strategy. The complexity and diversity of the

threat demands the application of a balanced and layered strategic approach that is fluid and capable of not only responding to current threats but also anticipating and preparing for those in the future.

In stark contrast to conventional wisdom on the topic, this research finds that the security of domestic weapons and fissile materials must be afforded the highest level of importance. A security breach within the domestic nuclear complex would effectively bypass most other layers of security, could significantly shorten the timeline for interdiction prior to an attack, and signal weakness to other nations with whom the U.S. is seeking to establish or maintain cooperative security arrangements.

Although contrary to the opinions of most experts on the subject, overseas source security measures should fall second in the order of importance. While these programs clearly hold current value and the potential to be exceedingly effective, they require the clearance of diplomatic hurdles before implementation and represent potentially unpredictable security means. These programs can only be undertaken when the host nation agrees to accept the terms of the cooperative security arrangement until which time the issue remains a diplomatic rather than an implementation or appropriation concern. Other factors, previously discussed, concerning the limited reliability, comprehensive application, and verification of these measures reduce their comparative threat reduction capacity. It appears that despite the governmental and scholarly contention that securing overseas fissile materials should represent the first and possibly only focal area, it is not currently funded accordingly nor should it be. The intersection of preventive programs and the risk factors associated with the terrorist nuclear threat demonstrate that a broad collective effort is both beneficial and necessary.

U.S. border security and arriving cargo screening falls next in the order of importance. U.S. border and port security measures are currently far from impenetrable, but do provide a deterrent that further complicates terrorist activity and heightens the risk of detection. Despite the contention that foreign source security represents the first line of defense, this research calls into question the utility and reliability of this depiction. The notion of lines of defense suggests concentric perimeters or sequential lines that hold some degree of continuity and reliable defensibility. This research has shown that while

useful, foreign source security and overseas border and cargo screening measures cannot be viewed as a reliable or comprehensive line of defense. In protecting the U.S. from a domestic act of nuclear terrorism originating from an overseas location, the U.S. border represents the most logical boundary that could approach forming a true line of defense. While the U.S. border cannot currently be considered impervious, it is within the unilateral capacity of the U.S. to implement whatever security measures it might take to achieve this objective.

Transitory security measures that fall outside the U.S. border should be considered last in the order of importance. This layer of security encompasses a great deal of distance and space that generates both challenges and opportunities. Distance and space can be viewed as an impediment that a prospective terrorist must contend with that can also equate to time and opportunity for defenders to detect, track, and interdict suspected terrorist shipments. At the same time, space and distance increase the difficulties of employing any substantive or definitive screening or detection architecture. Certainly, overseas cargo screening and border security could play a more significant role in reducing the threat of a nuclear terrorist attack if resourced and implemented on a more aggressive scale. Ultimately, however, this represents an area where collaborative efforts and strategically applied measures might be more effective in shaping the threat environment as opposed to attempting to achieve any sort of absolute barrier.

While outside the scope of direct preventive efforts, RDT&E and administrative costs support each of the four prioritized operational areas of importance and should not be diminished or overlooked. The general capacity for progress and continued implementation in each of the other areas rely heavily on R&D, training, and administrative support. Clearly, the current screening and detection technology is not sufficient to consistently or reliably identify the movement of nuclear weapons or fissile material. While these ancillary functions may not garner the same political support as the more prominent efforts, improvement of the most vulnerable aspects of the Global Nuclear Detection Architecture can only be rectified through a much greater political and fiscal emphasis on R&D efforts.

Having established a programmatic order of importance based upon both the current effectiveness and future capacity for each security approach to reduce the threat, the next logical step is to determine which areas require additional resources to produce the most significant improvements in the security environment.

2. Calibration of Resource Prioritization and Distribution

The prioritization of programs and focal areas does not directly prescribe how resources should be apportioned or recalibrated. In this case, programs with a lower priority demonstrate the potential to provide the greatest degree of security improvement per dollar invested.

The domestic security afforded to U.S. nuclear weapons and fissile materials is second to none. While constant vigilance and continued security reviews and upgrades are necessary, the resources invested in this area appear sufficient. The exceptional strength of security efforts in the domestic arena suggests an imbalance might exist among other less well resourced areas that could create vulnerabilities in the overall security architecture.

Source security measures are important and beneficial but not foolproof or comprehensive. Proactive overseas source-security measures are not under-funded or under-emphasized when systematically compared to the importance and effects of other elements within the protective architecture. While the funding of overseas proactive source-security programs might not appear to adequately emphasize their widely promoted utility over reactive security or crosscutting programs, this research concludes that these programs receive the funding necessary to keep pace with the opportunities for implementation. More diplomatic emphasis might produce additional opportunities to apply overseas source-security measures but until that time, efforts approved for implementation have been adequately resourced. In the overseas proactive security arena, resources should focus on securing fissile materials where opportunities exist, with the utmost urgency. The formation of a preapproved pool of resources to facilitate a rapid response might bypass some of the domestic political delays that could otherwise impede responding to a rapidly emerging opportunity.

The funding and urgency of U.S. border related security measures should be substantially increased. Ultimately, the U.S. border represents a first and last line of defense against external threats. Enhancing border security at ports, border crossings and remote areas would provide benefits to security across a wide range of threats including narcotic and human trafficking as well as that of nuclear terrorism. Due to the inability to secure all sources, strengthened U.S. border security represents a crucial but underemphasized element in the preventive strategic framework and one entirely under U.S. authority to improve.

Among the overseas reactive security programs, funding should be increased to aid in strengthening this strategic layer of security. While this investment should not represent the highest priority, the capacity for these efforts to influence terrorist intent and capability is substantial. As a compartively weak point in the Global Nuclear Detection Architecture, increased resources applied to both technological and organization improvements could aid in strengthening these capabilites and balancing their contribution to the overall effort to prevent acts of nuclear smuggling and terrorist violence.

While not directly comparable to the aforementioned operational efforts to prevent a domestic nuclear terrorist attack, RDT&E, and other crosscutting programs represent underpinning functions that hold the potential to vastly improve the capabilties of the other lines of operation. The current detection and screening shortfalls characterize one of the areas where the greatest need for improvement resides. A dramatic advance in technology that would allow long-range or highly sensitive screening and detection could in itself provide the capacity to correct many of the border and cargo security concerns that currently diminish the effectiveness of the overall security architecture. A significant increase in resources should be applied to these functions as an investment toward future improvements.

3. Flexibility and Resource Apportionment

The last conclusion serves as a qualifier for the implementation of actions suggested within the first two conclusions (Figure 8). The conclusions provided herein

are based upon current observations of both the effectiveness of preventive programs and the threat depiction. The fluid nature of both demand the ability to apply resources and emphasis in a flexible manner.

In consideration of these conclusions, this research does not advocate a zero-sum solution. This recommendation does not suggest a static level of funding or a fixed proportional distribution. Currently, a significantly greater investment in U.S. border security and cargo screening reflecting the urgency and potential consequences of the threat are in order. Additionally, increased emphasis on RDT&E and training represent other areas of critical importance for both current and future security effectiveness. Finally, additional resources applied to overseas reactive security programs could aid in filling many of the gaps that exist, promote the benefits of international cooperation, and bolster the deterrent effects of a broad and collaborative security apparatus.

While commonly depicted as the single greatest threat facing the U.S., the Global Nuclear Detection Architecture accounts for less than .1 percent of the annual federal budget.[276] A single B2 bomber, priced at $2.5 billion accounts for nearly as much as the entire Global Nuclear Detection Architecture annual appropriation.[277] If the U.S. truly acknowledges the credibility of the threat of a domestic nuclear terrorist attack, an investment that reflects the gravity of this threat should be committed. While this research does not support the unfocussed application of additional resources, it does suggest that targeted and significant funding increases in the critical areas of U.S. border and cargo screening and R&D represent the best solution for strengthening the performance of the Global Nuclear Detection Architecture and improving U.S. national security.

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[276] Office of Management and Budget, "Updated Summary Tables, " (May 2009) http://www.whitehouse.gov/omb/budget/fy2010/assets/summary.pdf, 3.

[277] Center for Defense Information, "The B-2 Spirit Bomber," (May 1996) http://www.cdi.org/issues/aviation/B296.html.

Program Category Prioritization	Percent of Annual Budget	Funding Calibration/Prioritization	Justification
OPERATIONAL EFFORTS			
1. Proactive Domestic Security Programs	30% ($846 million)	Maintain current funding and increase as necessary to retain dominance	Failure would allow terrorists to bypass numerous other layers of security and signal weakness to other interested terrorists and cooperative security assistance partners
2. Proactive Overseas Security Programs	19% ($540 million)	Maintain current level of funding but develop the capacity to quickly apply additional resources when opportunities emerge	Direct impact on security but incomplete and likely to remain so; capable of affecting threat intent and capability factors to produce a significant deterrent effect
3. Reactive U.S. Border and Port Security	8% ($209 million)	Number one priority for additional resource appropriation	The only realistically feasible "line of defense," and completely within the purview of U.S. policy makers to pursue improvements, weakest layer of defense with the greatest capacity for improvement
4. Reactive Overseas Security Programs	14% ($400 million)	Number three priority for additional resource appropriation	Less tangible direct effects but still capable of influencing threat intent and capability factors to produce a significant deterrent effect
NON-OPERATIONAL EFFORTS			
5. Crosscutting Security Programs (RDT&E and training)	21% ($577 million)	Number two priority for additional resource appropriation	Backbone of human capital development and the implementation of virtually every preventive program; the foundation for future technological advancement
Administrative Costs	8% ($231 million)	N/A	Overhead expense

Table 8. Prioritization of Programmatic Funding and Justification

B. ADDITIONAL RECOMMENDATION TO CENTRALIZE MANAGEMENT

To determine an optimal balance of funding among preventive programs, one must continuously reevaluate the comparative security advantages and capabilities of each constituent effort. As one security measure is strengthened, another will become comparatively weaker. Terrorists do not set out with the goal to fail. They will naturally gravitate toward areas of weaker security and away from areas with security that is more stringent. This natural tendency, to follow the path of least resistance, can work to the defenders advantage if each preventive effort is applied under a single, integrated, strategic, and authoritative framework.

This analysis shows that no single facet of the Global Nuclear Detection Architecture has the capacity to prevent an act of domestic nuclear terrorism. This reality forces the necessity of skillfully integrating all of the preventive programs to create a collective defensive strategy that imposes the greatest degree of difficulty and risk of interdiction upon terrorist actors. The constituent programs within the Global Nuclear Detection Architecture appear to be lacking in many regards, including speed of implementation, total allocation of funding, and coherent strategic management of cross-departmental efforts. President Obama’s 2009 appointment of Gary Samore as the WMD Czar may hold promise for improving the integration and oversight of nuclear terrorism preventive programs. However, not unlike the turmoil caused when the Office of the Director of National Intelligence (ODNI) was created to integrate the IC, without statutory funding and staffing authority, Samore’s ability to effect change may be constrained. Lessons learned from the ODNI integration, such as the lack of authority over the constituent agencies, should be applied to shorten the learning curve and expedite the process for making substantive implementation and integration changes.

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